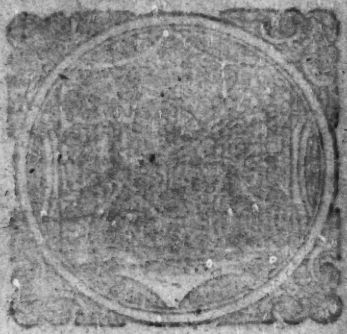
THE AMANS SECRETS.

ded into 2. partes, wherein is taught the
ules of Sayling, Horizontall, Paradoxall, and sayling vpon
Circle: also an Horizontall Tyde Table for the easie finding
bbing and flowing of the Tydes, with a Regiment easily calcu-
lated for the finding of the Declination of the Sunne, and ma-
ny other most necessary rules and Instruments, not
heretofore set forth by any.

w corrected by the author *Iohn Davis* of *Sandridge*,
neere *Dartmouth*, in the County of *Deuon*, Gent.

Imprinted at London by Thomas Dawson,
lling neere the three Cranes in the Vintree,
and are there to be solde. 1595



To the right honourable Lord Charles Howard, Baron of Effingham, Knight of the noble order of the Garter, Liuetenant of her Maiesties Counties of Sussex and Surrey, Constable of her Maiesties Honor and Castle of Windsor, Lord high Admirall of England, Ireland, and Wales, and of the Dominions and Isles of the same, of the towne of Callis and marches thereof, Normandy, Gascony, and Guynes, Captaine generall of her Maiesties Seas and Nauie royall, and one of her Maiesties most honorable priuie Counsell. Iohn Davis wisheth increase of honour and perfect felicitie.

RIght Honourable and my especiall good Lord, as by the instinct of nature all men are desirous of knowledge, and take pleasure in the varieties of vnderstanding, so it is likewise ingraffed by the same benefit of nature, in the harts of true nobilitie, not onely to excell the vulgare sort but also to cherrish, support, and countenance all such as shall in due course prosecute their vocation: and as such practises eyther speculatiue or mecanicall, shall receiue fauourable place in the honourable opinion of nobilitie, by so much the more shall the practiser be esteemed: which is the cause that at this time imboldneth me presently vnto your most honourable fauour this small treatise of Navigation, being a briefe collection of such practises as in my seuerall voyages I haue from experience obserued. Among which in my three seuerall attempts for the discouerie of the Northwest passage, thereby to finde a shorte and Navigable course vnto the riche and famous Countries of *Cathayo*, *China*, *Pegu*, the Isles of *Molucas* and *Philippinas*, that thereby to the great and inestimable benefite of our Countrie, there might be a free and plentifull trade procured betweene vs and the said nations in short time to be performed, and with great safetie in regarde of the course: which action and enterprise (by meanes of that honourable Counseller Sir *Frauncis Walsingham* late principall Secretary to her Maiestie) was with good resolution accepted by the Marchants of London, but in the decay of his honourable life, the attempt was likewise

wise quailed: but howsoeuer mens mindes alter, yet vndoubtedly there is a p
nauigable, and easie to be performed by that course (whensoeuer it shall please G
to reueale the same) by inuincible reasons, and sufficient experience to be proue
although before I entred into that discouery, I was sufficiently perswaded of the
trinitie thereof, by historicall relation substantially confirmed, whereof to me
tures I made sufficient proofe, but especially to my worshipfull good friend
William Sanderson, the onely Merchant that to his great charges with most
trauaile did labour for the finishing thereof: yet I thanke God that of late
beene my very good chaunce to receiue better assurance then euer before of the
raintie of that passage, and such was my vehement desire for the performance
of, that thereby I was onely induced to goe with M. *Candishe* in his second
for the South Seas, vpon his constant promise vnto me, that when we came
Californio, I should there haue his Pinnace with my owne Barck, (which for
purpose went with me to my great charges) to search that Northwest discouery
those backe partes of *America*, but God hath otherwise disposed our purpos
deuine Iudgments, for M. *Candishe* being halfe way through the straights of
gilane, and impatient of the tempestious furiousnes of that place, hauing all his
and company with him, returned for *Brasil*, by the authority of his commaund
with a leading winde we might haue passed the same, and returning more
leages toward *Brasil*, my selfe being in his Ship named the *Desire*, without
Oares, Sayles, Cables, cordage, victuals, or health of my company sufficient
attempt, was seperated in a frette of weather, and forced to seeke the next shore
releefe, and recouering a harborow by vs named Port Desire, being in the
deg. did there repaire my most miserable wantes, and there staying foure mo
most lamentable distresse, did againe conclude with my company to giue an
tempt to passe the straights, as my best meane to gayne releefe. And there
was in the South Seas, but still by furious weather forced backe againe
standing all this my labour to performe the voyage to his profite, and to
selfe, (for I did aduenture and my good friends for my sake 1100. pounds in
on.) M. *Candishe* was content to account me to be the authour of his ouer
and to write with his dying hand that I ranne from him, when that his owne
returned many moneths before me.

I am bolde to make this relation vnto your Lordship, onely to satisfie your
nour of my conuersation, for were I faultie of so foule a crime, I were worthy
thousand tormentes, in presuming to present this Treatise to your honourable
ship, and now referring my cause to your Lordships consideration, I will
turne to my purpose.

In those Northwest voyages where Nauigation must be executed in most
sorte, in those attempts I was enforced to search all possible meanes requ

[illegible] which occasion I haue gathered together this breefe treatise, which with my [illegible] dedicate to your most honourable protection, being desirous if it lay in my [illegible] do farre greater matters in your Lordships seruice, hoping of your honou[illegible] because it is onely done to shewe my dutifull affection, and not for any [illegible] that the worke containeth. For I thinke there be many hundreds in Eng[illegible] can in a farre greater measure and more excellent methode expresse the no[illegible] of Nauigation, and I am fully perswaded that our Countrie is not inferiour [illegible] men of rare knowledge, singular explication, and exquisite execution of the [illegible]thematike, for what Strangers may be compared with M. *Thomas Digges* [illegible] Countryman the great master of Archmastrie, and for Thericall specula[illegible] most cunning calculation M. *Dee* and M. *Thomas Heriotts* are hardly to [illegible]; and for the mecanicall practises drawne from the Artes Mathematicke, [illegible] doth yeelde men of principall excellentie, as M. *Emery Mullaneux* [illegible] exquisite making of Globes bodies, and M. *Nicholas Hellyar* for the singu[illegible] portrature haue the praise of Europe, M. *Baker* for his skill and surpassing [illegible] knowledge for the building of Ships aduantageable to all purpose, hath not [illegible] his equall.

[illegible] now that I may returne to the painefull Seaman, it is not vnknowne to all [illegible] the earth, that the English goeth before all others in the practises of say[illegible] appeareth by the excellent discouery of Sir *Fraunces Drake*, in his passage [illegible] straights of Magilane, which being then so rawly knowne, he could not [illegible] vnlesse he had beene a man of great practise and rare resolution: so much [illegible] say, because I haue seene and tasted the frowardnes of the place, with [illegible] vnlikelyhoode of any passage to be that way.

[illegible] here repeat the most valiant and excellent attempts of Sir *Hugh Willough*[illegible] *Hawkins*, Sir *Humfry Gilbert*, and your Lordships seruant M. *George* [illegible] with diuers others that haue giuen most resolute attempts in the practises [illegible] as well for the discouery as other execution, whereby good proofe is [illegible] not onely in the skill of Nauigation, but also in the mecanicall execution of [illegible] of sayling, we are not to be matched by any nation of the earth.

[illegible] Nauigation is the meane whereby Countryes are discouered, and com[illegible] drawne betweene nation and nation, the worde of God published to the [illegible] of the forraine ofcastes from whence it hath pleased his deuine Ma[illegible] to detaine the brightnes of his glory: and that by Nauigation common [illegible] through mutuall trade are not onely susteined, but mightily enriched, with [illegible] esteeme ought the painefull Seaman to bee imbraced by whose harde [illegible] such excellent benefites are atchieued, for by his exceeding great hazzards [illegible] of the earth, the quantities of Countries, the diuersitie of nations and the [illegible] of Zones, Climats, countries and people, are apparantly made known vnto vs:

 Besides

Besides, the great benefites mutually interchanged betweene nations, of such [illegible] commodities, and artificiall practises wherewith God hath blessed eache [illegible] Countrie, coast, and nation, according to the nature and scituation of the place.

For what hath made the Spaniard to be so great a Monarch, the Comman[illegible] both Indias, to abound in wealth and all natures benefites, but onely the painefull [illegible] dustrie of his Subiects by Nauigation: their former trade was onely figs, Orenges, [illegible] Oyle, but now through Nauigation it is brought to be golde, siluer, pearles, silkes, [illegible] spice, by long and painefull trade recouered. Which great benefites onely by her Ma[illegible] iesties louing clemencie and mercifull fauour he doth possesse: for if her highnes [illegible] her most honourable Lordes would not regarde the small distance betweene her do[illegible] minions and those famous rich kingdomes, the easines of the passage being once [illegible] couered, (the Northwest I meane) with the full sufficiencie of her highnes Subiects [illegible] effect the same, there could then be no doubt but her stately seate of London [illegible] be the storehouse of Europe, and a nurse to all nations, in yeelding all Indian com[illegible] dities in a farre better condition, and at a more easie rate then now brought vnto [illegible] exchanging commodities of our owne store, with a plentifull returne at the [illegible] hand, which now by many exchanges are brought vnto vs.

Then should the Spaniard againe returne to his olde trade, and our sacred Sou[illegible] raigne bee seated the Commaunder of the earth: which trade and most fortu[illegible] discouery, we aboue all nations ought most principally to regarde, because of the [illegible] gularitie and inuincible force of our Shipping, which is not onely the commo[illegible] fortresse of our Countrie, but also the dread of our aduersary, and glory of our nation, wherein we doe in no sorte flatter our selues, for it was made apparant to all nation of the earth, by the late moste famous conquest that her Maiestie had against [illegible] huge supposed inuincible fleete of the Spaniard, being by her natie vnder the [illegible] maund of your Lordship who there in person and in place of her Maiestie, to your eternall glorious fame did disgrace their glory, and confound their force, and [illegible] their weakenes by their dastardly flight, through Gods prouidence and your [illegible] ships stately resolution.

Then sith Nauigation is a matter of so great moment, I suppose that euery man is bound in dutie to giue his best furtherance thereunto: among whome as the mo[illegible] vnmeete of all, yet wishing all good to the painefull traueller, I haue published this shorte treatise, naming it the *Seamans Secrets*, because by certaine questions de[illegible] maunded and answered, I haue not omitted any thing that appertaineth to the di[illegible] cret of Nauigation, whereby if there may growe any increase of knowledge or ease in practise, it is the thing which I chiefely desire.

To manifest the necessary conclusions of Nauigation in breese and shorte tearmes is my onely intent, and therefore I omit to declare the causes of tearmes and diffi[illegible] nition of artificiall wordes, no matter superfluous to my purpose, neither haue I [illegible] downe

the cunning conclusions apt for Schollers to practise vpon the shore, but one-
ly things that are needefully required in a sufficient Seaman: beseeching your
able Lordship to pardon my boldnesse, and with your fauourable counte-
nance to regarde my dutifull affection, I most humbly commit your good
Lordship to the mercies of God, who long preserue your
health with continuall increase of
honour.

From *Sandrudge* by *Darthmouth* the 20. of
August. 1594.

Your Lordships in all dutifull
seruice to commaund,
Iohn Dauis.

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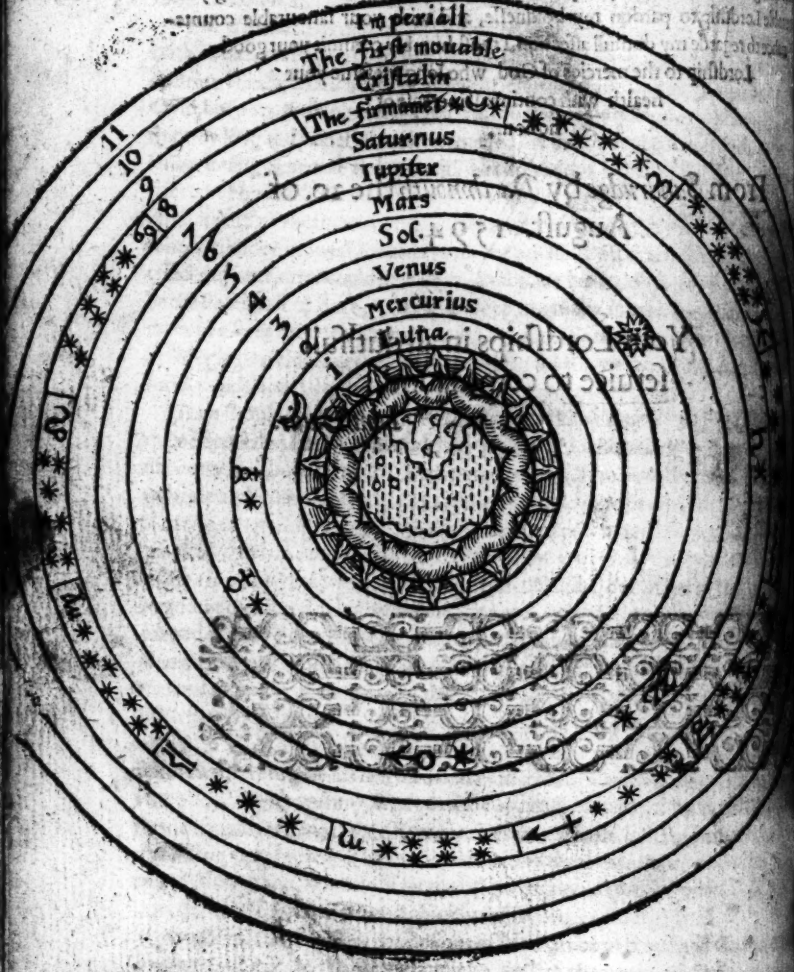
Empériall
The first mouable
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The firmamẽt
Saturnus
Iupiter
Mars
Sol.
Venus
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THE FIRST BOOKE OF THE *SEAMANS SECRETS.*

What is Nauigation?

NAuigation is that excellent Arte which demonstrateth by infallible conclusion, how a sufficient Ship may be conducted the shortest good way from place to place, by Corse and Trauers.

What are those infallible conclusions?

NAuigation consisteth of three partes, which being well vnderstood and practised, are conclusions infallible, whereby the skilfull Pilote is void [illegible] to effect the thing purposed. Of which, the first is the Horizontall [illegible], which manifesteth all the varieties of the Ships motion, with[illegible] Horizontall plaine superficies, where euery line drawne is supposed a [illegible].

The second is a paradoxall or Cosmographicall Nauigation, which [illegible] the true motion of the Ship vpon any course assigned in longi[illegible] and distance, either perticular or general, and is the skilfull ga[illegible] together of many Horizontall Corses, into one infallible and true [illegible] paradoxall.

The third is great Circle Nauigation, which teacheth how vpon a great [illegible] drawne betwéene any two places assigned, (being the only shortest [illegible] betwéene place and place) the Ship may be conducted, and is perfor[illegible] the skilfull application of Horizontall and paradoxall Nauigation.

What is a Corse?

A Corse is that paradoxall line which passeth betwéene place and place, according to the true Horizontall position of the Magnet, vpon which [illegible] the Ship prosecuting her motion, shall be conducted betwéene the saide [illegible].

What is a Trauers?

A Trauers is the varietie or alteration of the Shippes motion vpon the shift of windes, within any Horizontall playne superficies, by the good

collections

collection of which Trauerſes, the ships vniforme motion or Corſe is giuen.

What Inſtruments are neceſſarie for the execution of this excellent skill?

THe Inſtrumentes neceſſarie for a skilfull Seaman, are a Sea Compaſſe, a Croſſe ſtaffe, a Quadrant, an Aſtrolabie, a Chart, an inſtrument magneticall for the finding of the variation of the Compaſſe, an Horizontall plaine Sphere, a Globe, and a paradorall Compaſſe. By which inſtruments all concluſions and infallible demonſtrations, Hidrographicall, Geographicall, and Coſmographicall, are without controlement of errour to be perfourmed: but the Sea Compaſſe, Chart, and Croſſe ſtaffe, are inſtruments ſufficient for the ſeamans vſe: the Aſtrolabie and Quadrant being inſtruments very vncertaine for Sea obſeruations.

What is the Sea Compaſſe?

THe Sea Compaſſe is a principall inſtrument in Nauigation, representing and diſtinguiſhing the Horizon, ſo that the Compaſſe may conueniently be named an Artificiall Horizon, becauſe by it are manifeſted all limits and diſtinctions of the Horizon required, to the perfect vſe of Nauigation, which diſtinctions are the 32. points of the Compaſſe, whereby the Horizon is deuided into 32. equall partes, and euery of thoſe points hath his proper name, as in the figure following appeareth. Alſo euery point of the Compaſſe doth containe degrées, minuts, ſeconds, and thirds, &c. Which degrées are called degrées of Azimuth whereof there are in euery point 11 ¼. For the whole Compaſſe or Horizon containeth 360. degrées of Azimuth, but you multiplie 11 ¼. degrées, the degrées that ech point containeth, by 32. the points of the Compaſſe, it yeldeth 360. the degrées of the Compaſſe. And 15. minutes each point containeth 45. being ¾. of an howre, ſo that the whole Compaſſe is hereby deuided into 24. howers, by which accompt there is in an howre 15. degrées, ſo that euery degrée containeth 4. minutes of time, for an howre conſiſting of 60. minutes, hath for his fifteenth part 4. minutes of time, and in euery minute there is 60. ſecondes, and euery ſecond containeth 60. thirds, either in degrées applied to time, or degrées applied to meaſure; ſo that the generall content of the Compaſſe is 32. points, 360. degrées and 24. howers, with their minutes, ſecondes, and thirds.

What is the vſe of the 32. points of the Compaſſe?

THe vſe of the 32. points of the Compaſſe, is to direct the skilfull Pilote by Horizontall trauers, howe he may conclude the corſe or paradorall motion of his ſhip, thereby with the greater expedition to recouer the place deſired, becauſe they deuide the Horizon into ſuch limits as are moſt apt to Nauigation, they doe alſo diſtinguiſh the windes by their proper names, for

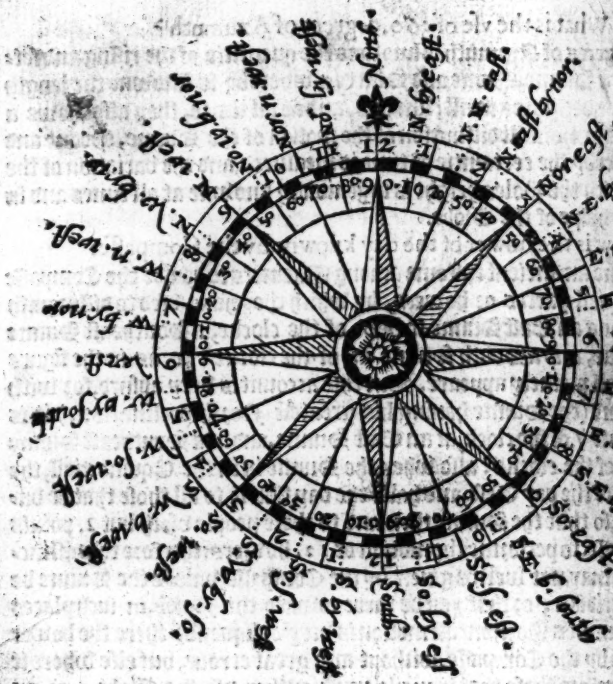
winde receiueth his name by that part of the Horizon from whence he bloweth.

What is the vse of 360. degrees of Azumuth?

By the degrées of Azumuth is knowne the quantitie of the rising and setting of the Sunne, Moone and Starres, whereby is knowne the length of the dayes and nightes in all climates, and at all times, they also shewe a most precise Horizontall distinction of the motion of the Sunne, Moone and Starres, wherby the certaintie of time is measured, and the variation of the Compasse, with the Poles height is ingeniously knowne at all times and in all places, by helpe of the Globe.

How is the hower of the day knowne by the Compasse.

It hath béene an ancient custome among Mariners to deuide the Compasse into 24. equall partes or howers, by which they haue vsed to distinguish time, supposing an East Sunne to be 6. of the clocke, a Southeast Sunne 9. of the clocke, and a South Sunne 12. of the clocke: &c. as in the figure following shall plainely appeare. But this account is very absurd, for with vs in England (the Sunne hauing his greatest North declination,) it is somewhat past 7. of the clock, at an East Sunne, and at a Southeast Sunne somewhat past 10. of the clocke: also when the Sunne is in the Equinoctiall, the same is halfe the day East, and halfe the day West, to all those that be vnder the same, so that the Sunne then and to those people vseth but 2. points of the Compasse, to performe the motion of 12. howers: therfore the distinction of time may not well be giuen by the Compasse, vnlesse the Sunne be neere the Meridian, or that you be farre toward the North, in such places where the Sunnes Horizontall motion is very oblique, for there the hower may be giuen by the Compasse, without any great errour, but else where it cannot. Therefore those that trauaile must eyther vse the Globe, or an Equinoctiall diall, by whom time may be most certainly measured, if there be good consideration of the variation of the néedle by which the Equinoctiall is directed, for this is a generall thing to be regarded aswell in the Compasse, as in any dials or other instrument or conclusion whatsoeuer wherein the vse of the néedle is required, that vnlesse there bee good regard had to the variation of the same, there can no good conclusion follow of any such practises.



What is the next necessarie thing to be learned.

HAuing perfectly learned the Compasse, the next necessarie thing for a Seaman to know, is the alteration or shifting of tydes, that thereby he may with the greater safetie bring his Ship into any barred Port, Hauen, Creeke, or other place, where tydes are to be regarded. And this difference of tides in the alteration of flowing and reflowing, is by long experience found to be gouerned by the Moones motion, for in such proportion of time as the Moone doth seperate her selfe from the Sunne, by the swiftnes of her naturall motion: in the like proportion of time doth one tide differ from another, therefore to vnderstand this difference of the Moones motion is the only meane whereby the time of tydes is most precisely knowne.

Of the Moones motion.

[illegible] must understand the Moone hath two kinde of motions, a naturall [illegible]tion, and a violent motion, her violent motion is from the East to [illegible] the West, caused by the violent swiftnes of the diurnall motion of pri[illegible] mobile, in which motion the Moone is caried about the earth in 24. [illegible] and 50. minuts nerest one day with another, for although the diur[illegible] of the first mouer be performed in 24. howers, yet because the [illegible] every day in her slowest naturall motion moueth 12. degrées, there[illegible] is not caried about the earth, untill that her motion be also caried a[illegible] which is in 24. howers and 50. minutes nerest.

[illegible] natural motion is from the West towards the East, contrary to the [illegible] of the first mouer, wherin the Moone hath 3. differences of mouing, [illegible] motion, a meane motion, and a slowe motion, all which is performed [illegible] ordinance of the Creator, in 27. daies and 8. howers nerest, [illegible] all the degrées of the Zodiac.

[illegible] slowe motion is in the point of Auge or apogeo, being then farthest [illegible] from the earth, and then she moueth in euery day 12. degrées.

[illegible] swift motion is in the oposite of age or perigeo, being thennerest vn[illegible] earth, at which time she mooueth 14. degrées, with some small diffe[illegible] minutes in euery 24. howers.

[illegible] those two points is her meane motion, & then she moueth 13. de[illegible] nerest, all which differences are caused by the excontricitie of her Orbs [illegible] she moueth, and are onely performed in the Zodiac, but the Sea [illegible] their better ease in the knowledge of tydes, haue applyed this the [illegible] motion, to the points, degrées, and minutes of the Compasse, where[illegible] haue framed it to be an Horizontal motion which sith by long prac[illegible] found to be a rule of such certaintie, as that the errour thereof brin[illegible] danger to the expert Seaman, therefore it is not amisse to followe [illegible] practised precepts therein.

[illegible] euery 29. daies 12. howers 44. minuts, one with another through the [illegible] the Sunne and Moone are in coniunction, and therefore that is the [illegible] of time betwéene change and change, for although the Moone in [illegible] and 8. howers performing her naturall motion, doth returne to the [illegible] minute of the Zodiac from whence she departed, yet being so returned, [illegible] not finde the Sunne in that parte of the Ecliptick where she lefte [illegible] the Sunne in his naturall motion mouing euery day one degrée to[illegible] the East, is mooued so far from the place where the Moone left him, [illegible] the Moone cannot ouertake the Sunne to come in coniunction with [illegible] she haue performed the motion of 2. daies, 4. howers, and 44. mi[illegible] nerest, more then her naturall reuolution, and that is the cause wher[illegible]

fore

fore there are 29. daies, 12. howers, 44. minutes, betwéene change & [illegible] one with another through the whole yere: but the Seaman accompt[illegible] Moones motion, to be vniforme in all places of the Zodiac alike limit[illegible] general seperation from the Sunne, to be such as is her slowest [illegible] tion, which is 12. degrées, or 48. minutes of time, in euery 24. howers.

By which accompt there are 30. daies reckoued betwéene change [illegible] change, being 11. howers, 16. minutes, more then in truth there is: [illegible] cause this difference breedeth but smal errour in their accompt of tides, [illegible] fore to alter practised rules where there is no vrgent cause, were a [illegible] friuolous, which considered, I thinke it not amisse that we proceede [illegible] by the same methode that commonly is exercised.

Allowing the Moone in euery 24. howers to depart from the Sunne [illegible] degrees, or 48. minutes of time, and in this separation the Moone [illegible] from the Sunne Eastwards, vntill she be at the full for betweene the [illegible] and the full, it is called the Moones seperation from the Sunne: [illegible] the full she doth apply towards the Sunne, so that betweene the [illegible] change it is called the Moones application to the Sunne, in which [illegible] application she is to the Westward of the Sunne, as in her separation [illegible] to the Eastward, or I may say in the Seamans phraise, all the time [illegible] application she is before the Sunne, and in the time of her seperation [illegible] abaft the Sunne.

Then if the Moone doe moue 48. minutes of time in 24. howers, [illegible] loweth that she doth moue 24. minutes in 12. howers, and in 6. howers [illegible] moueth 12. minutes, therefore euery hower she moueth 2. minutes, [illegible] as is the difference of her motion, such is the alteration of tides, and [illegible] euery tide differeth from the other 12. minutes, because there is 6. [illegible] betweene tide and tide, and in euery hower the course of flowing or [illegible] ing altereth 2. minutes, whereby it appeareth that in 24. howers the [illegible] tides of flowing and reflowing doe differ 48. minutes of time.

And sith the whole knowledge of this difference or alteration of tides [illegible] also the quantitie of the Moones separation and application to and from [illegible] Sunne, dependeth vpon the knowledge of the Moones age, it is therfore [illegible] cessarie that next you learne how the Sunne may be knowne.

For the perfourmance whereof there are 2. numbers especially [illegible] named the Prime and the Epact, for by the prime the epact is found, [illegible] helpe of the Epact the Moones age is knowne.

Of the prime or Golden number.

The Prime is the space of 19. yeers, in which time the moone perfo[illegible] al the varieties of her motion with the Sunne, and at the end of 19. [illegible] beginneth the same reuolution againe, therefore the Prime neuer [illegible] the number of 19. and this prime doth alwayes begin in January, [illegible]

[illegible] is found: vnto the yeere of the Lord wherein you desire to know [illegible] adde 1. then deuide that number by 19. and the remaining number [illegible] commeth not into the quotient is the prime. Example in the yeere of [illegible] 1590. I desire to know the prime, therefore I adde 1. vnto that [illegible] then it is 1591. which I deuide by 19. and it yeldeth in the quo[illegible] 83. and there remaineth 14. vpon the diuision, which commeth not into [illegible] quotient, which 14. is the prime in the yeere of our Lord 1590.

1590	1
1	74
	1591
	199 (83
1591	1527
	1
	5

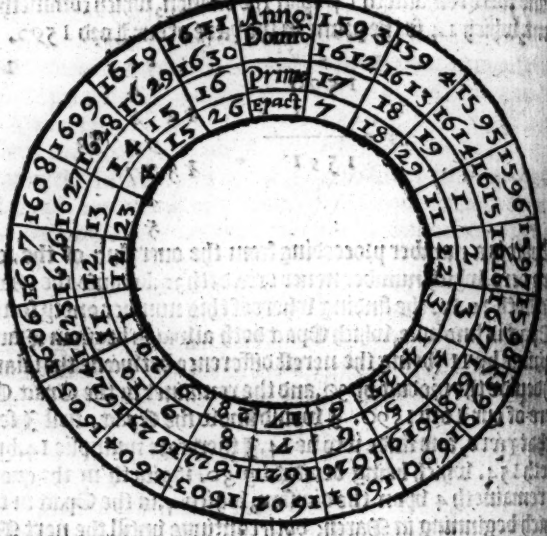
The Epact is a number proceeding from the ouerplus of the solar and lunar yeere, which number neuer exceedeth 30. because the Moones age [illegible] exceedeth 30. for the finding whereof this number onely serueth: and [illegible] the Epact is knowne, which Epact doth alwaies begin in March, mul[illegible] the prime by 11 (being the nerest difference betweene the solar and lu[illegible] yeere) deuide the product by 30. and the remainer is the Epact. Example [illegible] yeere of our Lord 1590. I would know the Epact, first I seeke the [illegible] of that yeere, and finde it to be 14. I therefore multiplie 14. by 11. and [illegible] yeldeth 154. which being deuided by 30. it giueth in the quotient 5. [illegible] remaineth 4 vpon the diuision, which 4. is the Epact in the yeere [illegible] which beginning in March, doth continue vntill the next March of [illegible] yeere 1591.

14	
11	15 (4
	130 (5
14	50
17	
154	

Of the solar and lunar yeere.

The solar yeere or the Suns yeere consisteth of 12. moneths, being 365. [illegible] daies, and about 6. howrs, the lunar yere or the Moones yere containeth [illegible] Moones, and euery Moone hath 29. daies, 12. howers, 44 minutes nerest, [illegible] amount vnto 354. daies, 5. howers, 28. minuts, the content of the lu[illegible] yeere, which being substracted from 365. dayes, 6. howers, there resteth [illegible] daies and 32 minutes, the difference betweene the said yeres, from which [illegible] the Epact commeth.

By this Table the prime and Epact may for euer be found, [illegible] yeeres be expired, you may begin againe and continue it to [illegible] pleasure.



The first circle contayneth the yeeres of our Lord, the second the [illegible] and the third and inner circle sheweth the Epact: vnder euery yeere [illegible] shall finde his prime and Epact, the prime beginneth in Januarie, and [illegible] Epact in March.

How to finde the Moones age.

The number of moneths.

First consider the day of the moneth wherein you seeke the Moone, [illegible] then note how many moneths there are betweene the sayd moneth [illegible] March, including both moneths, vnto those numbers adde the Epact of [illegible] yeere, that is, you must adde into one summe the day of the moneth, [illegible] March and your moneth, reckoning both moneths and the Epact, all [illegible] numbers ioyned together, if they exceede not 30. is the Moones age, if they [illegible] be more then 30. cast away 30. as often as you can, and the remainder [illegible] Moones age, if it be iust 30. it is then new Moone, if 7. it is the [illegible]

[illegible] if 15. it is full Moone, if 22. it is then the last quarter day, and thus the Moones age is found for euer.

And now being able for all times either past, present or to come, to giue the Moones age, I think it good by a few questions conuenient for the Seamans practise, to make you vnderstand the necessary vse thereof.

For the account of Tydes.

When you desire to knowe the time of full Sea in any place, at all such seasons as occasion shall require, you must first learne what moone maketh a full Sea in the same place, that is, vpon what point of the Compasse the Moone is, when it is full Sea at the said place, you must also know what hower is appropriated to that point of the compasse, as before is shewed: for vpon the change day it will alwaies be full Sea in that place, at the same instant of time, by which considerations you must thus proceed for the search of tydes.

Multiplie the Moones age by 4. deuide the product by 5. and to the quotient adde the hower which maketh full Sea in that place vpon the change day, if it exceede 12. cast away 12. as oft as you may, and then the hower of full Sea remaineth, and for euery 1. that resteth vpon your diuision, allow 12. min. to be added to the howers, for 2. 24. minuts, for 3. 36. and for 4. 48. minutes, for more then 4. will neuer remaine, and thus you may know your tides to a minute, Example, the Moone being twelue daies olde, I desire to know the time of full Sea at London: first it is found by experience, that a Southwest and Northeast Moone make full sea at London, next, I consider that 3. of the clocke is the houre appropriated to that point of the Compasse, which number I keepe in memory, then I multiplie the Moones age, being [illegible] by 4. and that yeeldeth 48. which being deuided by 5. it giueth in the quotient 9. and three remayneth, I adde the quotient 9. to the hower 3. and maketh 12. howers, and for the remayning number 3. I also adde 36. minutes, so that I find when the Moone is 12. daies old, it is 12. of the clocke, and 36. minutes past, at the instant of full Sea at London: by this order you may at all places & times know the certainty of your tides at your pleasure.

But those that are not practised in Arithmetick may account their tides in this sorte, knowing how many dayes old the Moone is, he must place the Moone vpon that point of the Compasse which maketh full Sea at the place [illegible], and then reckoning from that point with the sunne according to the [illegible] motion, must accompt so many points, and so many times 3. minuts as the Moone is daies old, that is for euery day one point and 3. minuts, and [illegible] finding the Sun, he must consider what is the hower allowed to that [illegible] where he findeth the Sunne. for that is the hower of full Sea. As for example, the moone being 12. daies olde, I desire to know the hower of full

Sea at London, nowe finding by former experience, that a Southwest Moone maketh full Sea at London, I therefore place the Moone upon the point Southwest, then I accompt from the point Southwest 12. points, renowing with the Sunne according to the diurnall motion, Southwest by west for the first point, West Southwest for the second, West by South for the third, West for the fourth point, and so forth untill I come to North, which is 12. points from Southwest, and because the Moone moueth 3. minutes more then a point in euery day, I therefore adde three times twelue, which make 36. minutes unto the point North, at which place I found the Sunne to be, and knowing that twelue of the clocke is appropriated to the point North, I may therfore boldly say that at twelue of the clocke 36. minutes past, it is full Sea at London, when the Moone is twelue dayes old, which 36. minutes are added, because the Moone hath moued 36. minutes more then twelue points in those 12. dayes, which is one point and 3. minutes for euery day, as before.

Heere followeth a very necessary Instrument for the knowledge of the Tydes, named an Horizontall tyde Table.

necessary
ente for
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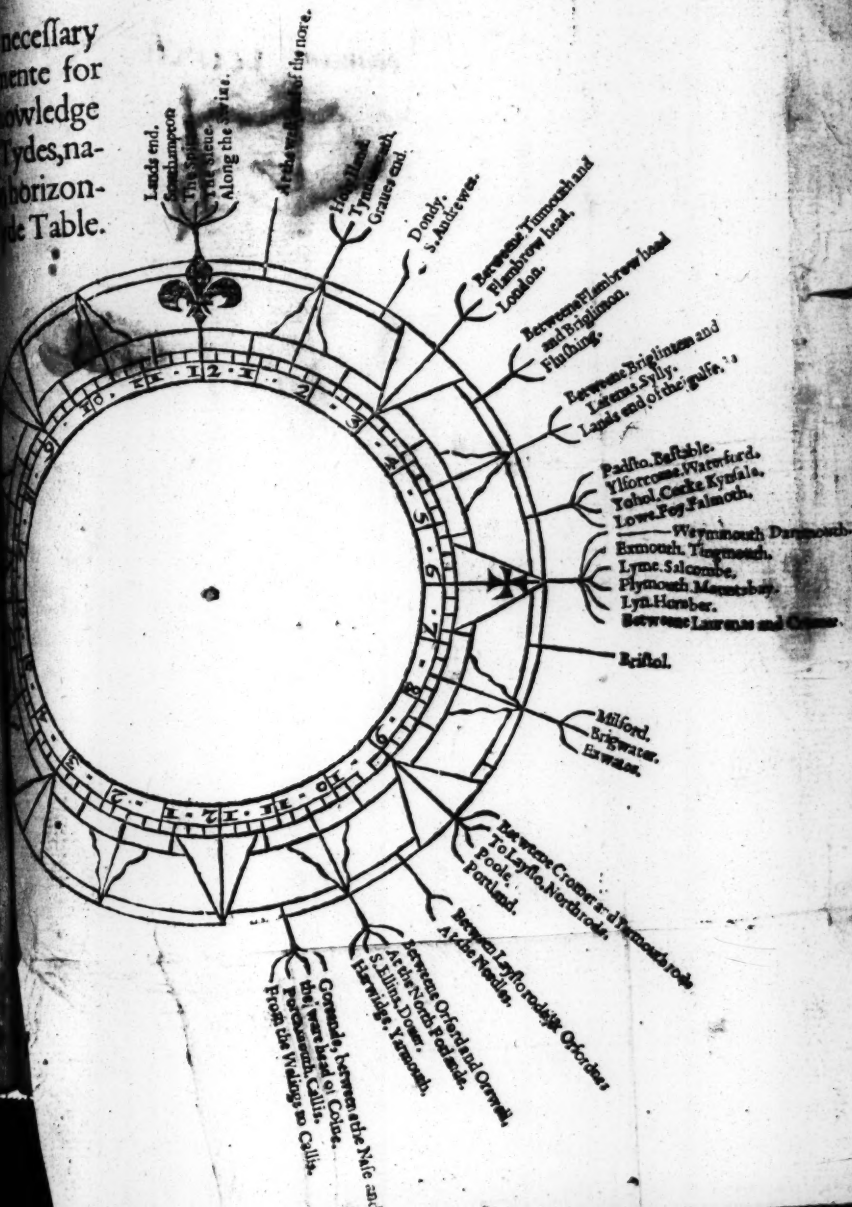
Tydes, na-
horizon-
le Table.



The Seamans Secrets

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The Seamans Secrets

The Seamans Secrets

Rec^d of John

Balcon

Of this Instrument and his partes.

[illegible] necessary instrument for the yong practising Seamans vse, [illegible] an Horizontall tyde Table, whereby he may shift his Sun and Moon [illegible] they terme it) and know the times of his tides with ease and very [illegible] besides the answering of many pleasant and necessary question vses [illegible] Mariners) I have contrived into this methode, onely for the bene[illegible] such yong practisers in Navigation.

The first parte of this instrument is a Sea Compasse, devided into 32. [illegible] or equall partes, the innermost circle of which Compasse is devided [illegible] 24. howers, and every of those into 4. quarters, each quarter being 15. [illegible], and against everie point of the Compasse those places are laybe [illegible], in which places it is full Sea when the Moone commeth vpon the [illegible] point, so that whatsoever is required as touching time, or the pointes [illegible] Compasse is there to be knowne.

The next moveable circle vpon this Compasse, is limited to the Sunne, [illegible] whose index the sunne is laide downe, which circle is devided into 30. [illegible] parts or daies, signifying the 30. daies between change and change, [illegible] to the Seamans accompt, so that whatsoever is [illegible] the age of the Moone, is vpon that circle to be knowne.

The vppermost moveable circle is applied to the Moone, vpon which [illegible] Moone is laid downe, which is to be placed either to the [illegible] of the Compasse, or to the time of her age, as the question [illegible] considered, the vse of this instrument is largely [illegible] with their answeres following.

[illegible] to know the hower of the night by the Moone, being vpon any point of the Compasse, by this instrument.

1. Q. The Moone 10. daies olde, I demaund what it is a clocke, when the [illegible] Northeast.

[illegible] In this question the Moones age and the point of the Compasse [illegible] therby to know the hower, I therfore place the index of the moone [illegible] point East Northeast, there keeping the same not to be mooned, then [illegible] the Moone is 10. daies olde, I moue the index of the Sunne [illegible] the tenth day of the moones age vnto the index of the moone, [illegible] by the Index of the Sunne and finde vpon the Compasse [illegible] of the clocke of [illegible] and 30. minutes past [illegible] point East Northeast, being 10. daies olde.

[illegible] The Moone being [illegible] daies olde, I [illegible] be vpon the point S.S.E.

2. A. In this question the point of the compasse and Moones age is gi
as in the first, therefore I place the inder of the Sun vpon the point S.
and there holding it without mouing, I turne the inder of the Sunne,
the twelfth day of the moones age come to the inder of the moone, and
the inder of the Sunne sheweth me vpon the Horizon the hower 8. th
I say that at 8. of the clocke at night the Moone was then vpon the
South Southeast.

And thus you may at all times know the hower of the night by the
vpon any point of the Compasse, so that the Moones age be also had.

How by this Instrument, you may know at all times vpon what point of the Compasse the Moone is.

1. Q. When the Moone is 10. daies olde, vpon what points of the C
passe will she be, at 9. of the clocke in the morning?

1. A. In this question the houre of the day and the Moones age is gi
thereby to finde vpon what point of the Compasse she is at the same ti
therefore place the Inder of the Sunne vpon the Compasse, at the hou
of the clocke in the morning, being vpon the point Southeast, then I
the inder of the Moone, until I bring it to the tenth day of her age, and
I see vpon the Compasse that the Moone is North and by east, and 15
to the East wards, at 9. of the clocke when she is 10. daies olde.

2. Q. When the Moone is 20. daies old, vpon what point of the com
will she be at 2. of the clocke in the after noone?

2. A. I place the Inder of the Sun vpon the hower 2. noted in the
passe, there holding the same without mouing, then I turne the Inde
Moone, until I bring it vnto the twentieth day of her age, and there I
on the Compasse that she is Northeast and by north, and 15. minutes
Northward, at 2. of the clocke in the afternoone, when she is 20. daies

To finde the Moones age by this Instrument.

1. Q. When the Moone is North at 7. of the clocke in the forenoone
olde is she?

1. A. In this question the point of the Compasse and the hower is
for the finding of the Moones age: therefore I set the Inder of the
vpon the hower 7. in the forenoone, there holding it without mouing
bring the Inder of the Moone to the point North, and then vpon the
containing the daies of the Moones age, I see the Moone is 8. daies
bout 18. howers old, when she is North at 7. of the clocke in the fore

2. Q. When the Sunne is East and the Moone Southwest, how
is the Moone?

A. In this question the points of the Compasse are onely giuen for the [illegible] of the Moones age, therefore I set the Inder of the Sunne vpon the [illegible] East, there holding him sedie, then I put the Inder of the Moone vp[illegible] point Southwest, and there I see that the moone is 18. daies and 18. [illegible] olde, when the Sunne is East and she Southwest.

[illegible] this order by the variety of these few questions, you may frame vn[illegible] selfe many other pleasant and necessary questions, which are very [illegible] answered by this Instrument: and entring into the reasons of their [illegible], you may very readily by a little practise, be able by memory to [illegible] all such questions with ease.

How to know the times of your tides by this Instrument.

Q. When the Moone is 12. dayes olde, I desire to know the time of [illegible] at London.

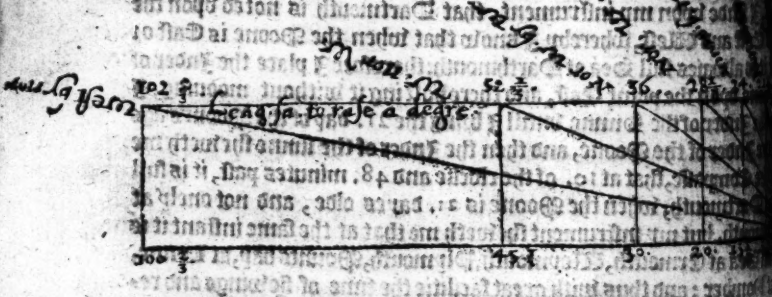
A. To answere this question, I first looke through all the pointes of [illegible] Compasse of my instrument, vntil I finde where London is written, for [illegible] the Moone commeth vpon that point of the Compasse, it will then be [illegible] at London: therefore I place the inder of the Moone vpon the same [illegible] which I find to be Southwest or Northeast, there holding the Inder [illegible] moued, then I turne the Inder of the Sunne vntill I bring the [illegible] day of the Moones age to the Inder of the Moone, and then the [illegible] the Sunne she weth me that at 12. of the clocke 36. minutes past, it [illegible] at London the Moone being 12. daies olde.

Q. The Moone being 21. dayes olde, at what time is it full Sea at [illegible]

A. I finde vpon my instrument, that Dartmouth is noted vpon the [illegible] East and West, whereby I know that when the Moone is East or [illegible] it is alwaies full Sea at Darthmouth: therefore I place the Inder of [illegible] vpon the point East, and there holding it without mooving, I [illegible] the Inder of the Snnne vntill I bring the 21. day of the Moones age [illegible] the Inder of the Moone, and then the Inder of the sunne sheweth me [illegible] the Compasse, that at 10. of the clocke and 48. minutes past, it is full [illegible] at Dartmouth, when the Moone is 21. dayes olde, and not onely at [illegible], but my instrument sheweth me that at the same instant it is [illegible] Sea at Exmouth, Weymouth, Plymouth, Mounts bay, at Lynne, [illegible] Homber: and thus with great facilitie the time of flowings and re[illegible] is most precisely knowne.

[illegible] now that there may be a finall ende of the vses and effectes of the [illegible], it is conuenient that I make known vnto you, how many leags [illegible] sailed vpon euery perticular point of the Compasse, for the raising or

 laying



Leages seperated from the Meridian in raising a degree.

Q. I perceive that degrees are to great purpose in Navigation. What is a degree?

[illegible] is most true, that degrees are of very great imploiment in Nauigation, and a degree is the 360. part of a circle, how big or little soeuer the [illegible] being applied after 6. seuerall sortes, for the better perfections of [illegible] Gubernaulick, so that there be degrees of longitude, degrees of [illegible] degrees of Azimuth, degrees of altitude, degrees applied to measure [illegible] degrees applied to time.

[illegible] of longitude is the 360. part of the Equinoctiall.

[illegible] of latitude is the 360 part of the Meridian.

[illegible] of Azimuth is the 360. part of the Compasse or Horizon.

[illegible] of altitude is the 90. part of the vertical circle, or the 90. parts [illegible] betweene the Zenith and the Horizon.

[illegible] degree applyed to measure, doth containe 60. minutes, and euery [illegible] 60. seconds, and euery second 60. thirds, &c. and euery degree of a [illegible] circle so applied, containeth 20. leages, which is 60. mile, so that euery [illegible] for a mile in the accompt of measure, and a mile is limited [illegible] paces, euery pace 5. foot, euery foot 12. inches, and euery inch 3. [illegible] dry and round, after our English accompt, which for the vse of [illegible] is the onely best of all other: so by these rates of measure you [illegible] that a degree is 20. leages or 60. miles, a minute is a mile or [illegible] a second is 83. feet, and a third is 16. inches: and thus much [illegible] those parts applyed to measure.

[illegible] applied to time, there are 15. contained in euery hower, so [illegible] degree of time standeth in the accompt of time for 4. minutes, for [illegible] consisting of 60. minutes of time, hath for his fifteenth part 4. mi[illegible] that a degree being the fifteenth part of an hower, containeth 4. mi[illegible] time, so that 15. degrees or 60. minuts make an hower, 24. howers [illegible] all day, and 365. daies 6. howers, are contained in a yeere, and [illegible] as touching time, and degrees applied to time.

What is the vse of degrees?

[illegible] of degrees is to measure distances betweene place and place, so [illegible] altitudes, latitudes, and longitudes, to describe countries, to distin[illegible], to finde the variation of the Compasse, to measure time, to [illegible] places and motions of all celestiall bodies, as the Sunne, Moone, [illegible] and Starres: to conclude, by degrees haue beene performed all [illegible] obseruations whatsoeuer, whose vse is infinite.

What is the Poles altitude, and how it may be knowne?

[illegible] is the distance, height, or mounting of one thing aboue another [illegible] the altitude of the pole, is the distance, height, or mounting of the [illegible] the Horizon, & is defined to be that portion of the meridian, which

is contained betweene the Pole and the Horizon, which altitude or [illegible]
is to be found either by the Sunne, or by the fixed Starrs, with the
your Crosse staffe, Quadrant, or Astrolabie, but the crosse staffe is the
best instrument for the Seamans vse.

And in the obseruation of this altitude there are 5. things especially
regarded: the first is, that you know your meridionall distance betwe
Zenith and the Sunne or Starr, which by your Crosse staffe or Quad
is giuen: the second, that the declination be truely knowne at the
your obseruation. And the other three are, that you consider whether
Zenith be betweene the Equinoctiall and the Sunne or Starres, or
the Equinoctiall be betweene your Zenith and them, or whether they
tween your Zenith and the Equator, for there is a seuerall order of
vpon each of these three differences.

Latitude you must also know, that so much as the pole is above the
rizon, so much is the Zenith from the Equinoctial, and this distance
the Zenith and the Equator is called latitude or videnelle, and is the
tion of the Meridian which is included betweene your Zenith and the
for, for it is a generall rule for euer, that so much as the Pole is
Horizon, so much the Zenith is from the Equinoctiall, so that in this
altitude and latitude is all one thing, the one hauing relation to the
the Meridian contained betweene the Pole and the Horizon, and
to that parte of the Meridian which is contayned betweene the
and the Equinoctiall.

You must further vnderstand, that betweene the Zenith and
is a quarter of a great circle, containing 90. degrees, so that know
much the Sunne or any Starre is from the Horizon if you take that
from 90. the remainer is the distance betweene the said body and the
as for example, if the Sunne be 40. degrees 37. minutes from the
I substract 40. deg. 37. min. from 90. and there remaineth 49. deg.
which is the distance betweene my Zenith and the Sunne, so that
ments that begin the account of their degrees at the Zenith conclude
in the Horizon, are of most ease for the finding of the latitude by
or fixed Starrs, because they giue the distance betweene the Zenith
body obserued, without further trouble, and that is the number
must haue, and for which you do search in your obseruational which
considered, you must in this sort proceede for the finding of the Poles
or altitude.

By the Sunne or fixed Starrs being betweene your Zenith & the Equi-
the latitude is thus found, in what part of the world soeuer you

First place the Crosse staffe to your eye, in such good sorte, as that
may grow no errour by the disorderly bling therof, for, vnlesse the

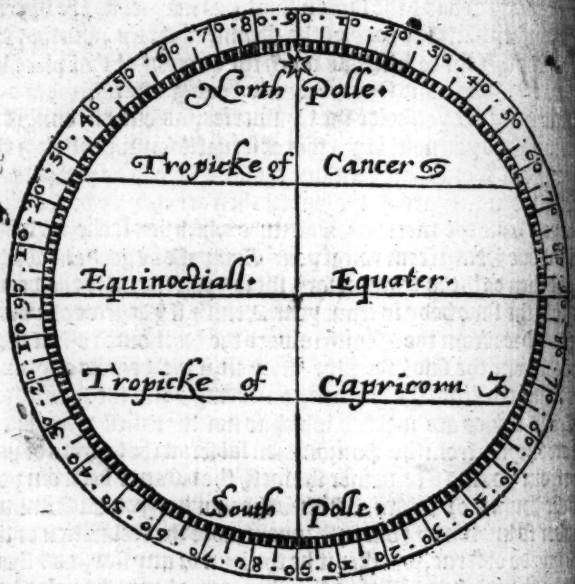
ur ſtaffe and the center of your ſight doe ioyne together in your ob-
on, it will be erronious whatſoeuer you conclude thereby: your ſtaffe
ed, then moue the tranſuerſary vpon your ſtaffe to and fro as occa-
reth, vntil at one & the ſame inſtant you may ſee by the vpper edg of
ranſuerſary halfe the body of the Sunne or Starr, and that the low-
or ende thereof do like wiſe touch the Horizon, at that place where it
h that the Skye and ſeas are ioyned, hauing eſpeciall regarde in this
obſeruation, that you holde the tranſuerſary as directly vpright as pol-
you may, and you muſt begin this obſeruatiõ ſomwhat before the Sun
rres be at South, and continue the ſame ſo long as you perceiue that
ſe: for when they are at the higheſt then are they vpon the Meridian,
hen you haue the meridionall altitude which you ſeeke, at which time
will be due South from you, if your Compaſſe be good and without va-
on, and then doth the tranſuerſary ſhew vpon the ſtaffe the degrées and
s that the ſayd body is from your Zenith, if ỹ degrées of your inſtru-
be numbred from the Zenith toward the Horizon: or elſe it ſheweth ỹ
ce betweene the ſaid body & the Horizon, if the degrées of your inſtru-
be numbred from the Horizon, concluding 90. in the Zenith as com-
y Croſſe ſtaues are marked, which is not the eaſieſt way: but if your
be accompted from the Horizon, then ſubſtract the degrées of your ob-
ion from 90. and ỹ remainer ſheweth the diſtance betweẽ your Ze-
and the Sunne or Starr, which is the number you muſt know: vnto
umber ſo knowen by your inſtrument, adde the declination of the body
hich you do obſerue, whether it be the Sun or any ſtar, and that which
eth by the addition of thoſe 2. numbers together is the poles height, or
itude of the place wherein you are: as for Example. In the yeere of
Lord 1593. the 3. day of March, the Sunne being then betweene my
th and the Equinoctiall, I obſerued the Sunnes Meridionall altitude
the Horizon to be 72. deg. and 20. min. but becauſe I muſt knowe the
ce of the Sun from my Zenith, I therefore ſubſtract 72. deg. 20. min.
90. deg. and there remaineth 17. deg. 40. min. the diſtance of the Sun
my Zenith, to that diſtance I adde the Suns declination for that day,
h by my Regiment I finde to be 3. degrées of South declination, and it
unteth vnto 20. deg. 40. min. ſo much is the South pole aboue ỹ Hori-
and ſo much is my Zenith ſouth from the Equinoctial, becauſe the Sun
ng South declination, and being betweene me and the Equinoctiall,
refore of neceſſitie the Antactick pole muſt be aboue my Horizon.

90—60—the diſtance betweene the Zenith and the Horizon.
20—the Sunnes altitude.

17—40—the Suns diſt. from ỹ Zen.
3—00—Sunnes declination.

20—40—Poles height.

red: but because Seamen are not acquainted with such calculations, I [illegible] fore omit to speake further thereof, sith this plaine way before taught [illegible] ficient for their purpose.



The vse of this Instrument.

By this instrument you may sufficiently vnderstand, the reasons of [illegible] soeuer is before spoken for the finding of the Poles eleuation, or [illegible] titude of your being: into the consideration whereof, because the young [illegible] tiser may the better enter, I thinke it not amisse by a few examples [illegible] presse the necessary vse thereof.

1. Q. The Sunne hauing 7. degrées of North declination, and the [illegible] Artick being 45. degrées aboue the Horizon. I demaund what will be [illegible] Sunnes meridionall distance from my Zenith?

1. A. First I turne the Horizon vntill I bring the North Pole to be [illegible] degrées aboue the same, there holding the Horizon not to be moued, I [illegible] bring the thrid that is fastened to the Center of the Instrument, 7. [illegible] from the Equinoctiall towardes the North, because the Sun hath so [illegible] North declination, and the thrid doth shew me vpon the verticall circle [illegible] the sunne is 38. degrées from my Zenith.

2. Q. [illegible]

Q. The pole arctick being 50. deg. aboue the Horizon, and the Suns di- 30. deg. from the Zenith, I demaund what is the Suns declination?

A. As in the first question I place the North pole 50. degrees aboue ...rizon, there holding the Horizon not to be moued, then I bring the ... in the 30. degree vpon the verticall circle, because the Sunne is 30. ... from my Zenith, and then the third sheweth vpon the Meridian be- ... the tropick of Cancer and the Equinoctiall, that the Sunne hath ...grees of North declination.

Q. The Sunne hauing 10. deg. of South declination, being vpon the ...dian, is 53. deg. from my Zenith, I demaund what is the poles height?

A. In the first question the Poles height and the Sunnes declination ...en, for the finding of the Sunnes meridionall distance from the Ze- ... In the second the Poles height is giuen, and the Sunnes meridionall ... from the Zenith, thereby to finde the Suns declination. And in this ...n the Sunnes declination and meridionall distance is giuen, for the ...g of the Poles height. I therefore bring the third fastned in the cen- ... instrument 10. degrees South from the Equator, betweene the ☾ qui- ...ll and the tropick of Capricorne. there holding the third not to be mo- ... Then turne the Horizon vntill I bring the 53. degree of the verticall ... vnder the third, and then the Horizon sheweth me, that the North pole ... degrees aboue the same.

Q. The Sun hauing 12. degrees of South declination and being vpon ...eridian South from me, is 30. degrees aboue the Horizon. I demaund ...arre the Sun is from my Zenith, how much the Equinoctiall is aboue ...rizon and what is the Poles height.

A. First I bring the third to the place of the Sunnes declination as be- ...here holding it not to be moued, then I turne the Horizon vntill I bring ... 30. deg. vnder the third, and then the third sheweth me that ẏ Sun is ...g from my Zenith, and the Horizon sheweth that the Equinoctiall is ...g. aboue the same, & that ẏ north pole is also elenated 48. deg. aboue ...rizon. Although these questions are so very easy and plain, as that they ...readily be answered by memory, yet because the reasons how they are ...ered may the better appear, is the cause wherefore they are demaunded ... this sort answered, only for the benefit of such as are not altogether ex- ... in these practises, that thereby they might likewise frame vnto them ... questions of other variety, and so gather thereby the more sufficient ...ment in this parte of Nauigation.

What is the Zenith.

The zenith is that prick or point in ẏ heauens which is directly ouer your ...head, from whence a line falling perpendicularly, will touch the place of ...ting, and so passe by ẏ center of the sphere, and this line may be called ... of the Horizon, and the Zenith the pole of the same being 90. deg.

The Sunne hauing 22. degrees of North declination, his altitu[illegible] the Horizon is obserued to be 3. degrees 15. minutes, therfore [illegible] 3. deg. 15. min. fron 22. degrees, there resteth 18. deg. 45. min. which [illegible] distance of the Equinoctiail from the Horizon, which being taken fro[illegible] there resteth 71. deg. 15. min. the poles eleuation desired.

g	m		g	m	
21	60	the Suns declination.	89	60	ẏ dist. betwéen Zen. [illegible]
3	15	the Sunnes altitude.	18	45	altitude of the Equ[illegible]
18	45	the altitude of the equinoctiall.	75	15	the altitude of the pole.

But you must know that the declination found in your Regiment, [illegible] the declination which in this case you must vse: for the regiment shew[illegible] Suns declination vpon the Meridian or South point, in the place for [illegible] Meridian the same was calculated, and not otherwise: therefore it is [illegible] sary to know the Suns declination at all times, and vpon euery point [illegible] Compasse: for I haue beene constrained in my northwest voiages, [illegible] within the frozen zone, to search the latitude by the Sun, at such times [illegible] could see the sun, vpon what poiut of the Compasse soeuer, by reason [illegible] great fogges and mistes that those Northern partes are subiect vnto: [illegible] there is consideration also to be had vpon euery difference of longitude [illegible] Sunnes declination, as I haue by my experience found at my being [illegible] straights of Magilane, where I haue found the suns declination to diff[illegible] my regiment calculated for London, by so much as the Sunne declin[illegible] 5. howers, for so much is the difference betwéen the meridian of Lond[illegible] the Meridian of Cape froward, being in the midst of the said straights.

How may this declination be found for all times, and vpon all points of the Compasse?

First consider whether the Sun be comming towards the Equin[illegible] or going from him, that being known, consider the time wherin you [illegible] the declination, then looke for the Sunnes declination in your regim[illegible] that day, and also seek his declination for the next day, substract the lesse[illegible] of the greater, and the remainer is the whole declination which the S[illegible] declineth in 24 howrs, or in his mouing through al the points of the C[illegible] pas, from which number you may by the rule of proportion find his decl[illegible] on vpon euery point of the compas or for euery houre of the day as by [illegible] examples may appeare. Example. In the yeere 1593. the 20. of Mar[illegible] desire to know the Suns declination when he is vpon the North part of [illegible] Meridian of London, I seeke the Suns declnation for that day, and find [illegible] to be 3. deg. 41. min. the Sunne then going from the Equator, I also se[illegible] his declination for the next day being the 21. of March, and find it to be 4[illegible] 3. min. I then substract 3. deg. 41. min. from 4. de. 3. min. and there rest[illegible]

...h much the Sun doth decline in 24. howers, or in going through all the ...s of the Compasse. Then I say by the rule of proportion, if 24. howers ...2. min. of declination what will 12. howers giue, &c. I Multiplye and ...e, and finde it to be 11. min, the Suns declination in 12. howers moti... be added to the declination of the 20. day, being the Sunnes going from ...Equator, or for the points of the Compasse I may say, if 32. points giue ...min. of declination, what will 16. pointes giue, which is the distance be...ne South and North: I multiply and deuide as the rule of proportion ...reth, and find that 16. points giue 11. min. the Suns declination, in mo...through 16. points of the Compasse, which is to be added to the declina... of the 20. day, because the Sun goeth from the Equator, so I conclude ...clination to be 3. deg. 52. min. the Sun being North the 20. of March.

po.	m.	po.	m.
4	22	12	11
	12		
	44	2	
	22	264	
	264	2	44(11
			44

po.	m.	po.	m.
32	22	16	11
	16		
	132	3	
	22	352	
	352	3	22(11
			3

...eing West from the Meridian of London 90. degrees of longitude, I ...to knowe the Suns declination when the Sun is vpon the Meridian ...0. of March 1593. I must here consider that 90. deg. of longitude make ...iers of time, for euery howre containeth 15. deg. whereby I know that ...the sunne is south at London he is but East from me, for when it is 12. ...clocke at London, it is but 6. of the clocke in the morning with mee, ...when it is 12. of the clocke with me, it is then 6. of the clocke in the after... at London: therefore I must seeke for the declination of the sunne at ...the clocke in the afternoone, and that is the meridionall declination ...I must vse, being 90. deg. West from London, which to doe, the last ...le doth sufficiently teach you, whereby you may easily gather the per...notice of whatsoeuer is requisite in any of these kinde of obseruations, if ...reade with the eye of reason, and labour to vnderstand with iudgement ...which you reade.

...here is another way most excellent for the finding of the Sunnes decli...on at all times, that is to search by the Ephimerides the Sunnes true ...e in the Ecliptick for any time purposed whatsoeuer, and then by the ta... of Sinus the declination is thus known. Multiply the Sinus of the suns ...itude from the Equinoctiall points of Aries or Libra, to which soeuer he ...rest, by the Sinus of the Suns greatest declination, and deuide the pro... by the whole Sinus, and the arke of the quotient is the declination desi...red:

When the Equinoctiall is betweene your Zenith and the Sun o
the latitude is thus found in all places.

BY your instrument as before is taught, you must seek the mer
stance of the Sun or Starres from your Zenith, which being
subtract the declination of the Sun or Stars from the said distan
remaining number is the poles height or latitude which you seek.

The 20. of October 1593. I find by my instrument that the S
deg. 45. min. from my Zenith at noone, being then upon the meri
quator being then betweene my Zenith and the Sun, I also find by
giment that at that time the Sun had 13. deg. 47. min. of South
on, because the Equinoctiall is betweene me and the Sun, therefo
stract the suns declination from the obserued distance, and there re
deg. 58. min. the latitude desired, and because the Sun hath south de
on, and the Equinoctiall being betweene me and the Sun, therefo
conclude, that the pole Artick is 46. deg. 58 min. aboue my Horizon,
my Zenith is so much toward the North from the Equator.

g	m	
59	15	the Sunnes distance.
13	47	the declination.
46	58	the latitude.

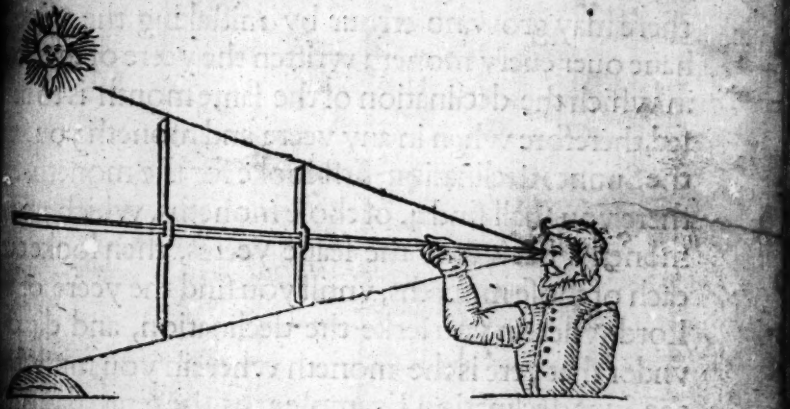
When your Zenith is betweene the Sunne or Stars and the Equino
the Latitude is thus found.

BY your instrument as in the first example is shewed, you must
ridionall distance of the Sunne or Starres from your Zen
must also by your Regiment or other tables, search to know the dec
of that body which you obserue, then subtract the obserued distan
your zenith out of the declination, and the remaining number is the l
desired: Example. The Sun hauing 20. deg. of North declination,
ing vpon the Meridian is 5. deg. 9 min. from my Zenith, I ther
5. deg. 9. min. from 20. deg. and there resteth 14. deg. 51. min. the latitu
red: and because the Sun hath North declination, my zenith being be
the Sun and the Equinoctiall, therefore I conclude that the North
14. deg. 51. min. aboue my Horizon.

g	m	
19	60	the Suns distance from my Ze
5	90	the declination.
14	51	the Poles height.

ſhall I know the true order of placing the Croſſe ſtaffe to mine eye, to auoyde errour in my obſeruation?

finde the true placing of the ſtaffe at your eye thereby to amend the ſmaller or falſe ſhadowe of your ſight, do thus: take a ſtaffe hauing two a long croſſe which endeth in 30. degrées, and a ſhort croſſe which be- at 30. deg. where the long croſſe endeth, put the long croſſe vpon his , and there make him faſt, then put the ſhort croſſe likewiſe vpon his her faſten him without mouing, then ſet the end of your ſtaffe to your ing it from place to place about your eye, vntill at one inſtant you the ends of both croſſes, which when you find, remember that place ſtanding of your body, for ſo muſt your ſtaffe be placed, and your body in all your obſeruations.



Are theſe all the rules that appertaine to the finding of the Poles height?

Pole that trauell farre towards the North vnder whoſe Horizon the Sunne letteth not, ſhall ſome time haue occaſion to ſeeke the latitude Sunne when the ſunne is North from them, the pole being then be- the Sunne and their Zenith. When ſuch obſeruations are made, you by your inſtrument ſeeke the Suns height from the Horizon, ſubſtract height from his declination, and the remayning number ſheweth how Equinoctiall is vnder the Horizon vpon the point North, for ſo much oppoſite part of the Equator aboue the Horizon vpon the point South, that Meridionall altitude of the Equinoctiall from 90. and the re- number is the poles height deſired. Example.

The vse of the Regiment.

FOrasmuch as the poles height cannot be obserued by the Sunne, vnlesse the Sunne true declination be knowne, I haue therefore carefully calculated these Tables Regiment, out of *Stadius Ephimerids*, the yeeres 1593. 94. 95. and 1596. which will serue vn the yeere 1612. without further correction: and bec there may grow no errour by mistaking the yeere haue ouer euery moneth written the yeere of the L in which the declination of the same month is to sed, therefore when in any yeere and moneth you the Sunnes declination, first looke for the moneth there you shall find 4. of those moneths, which a moneths betweene the leape yeeres, then looke each of those moneths, vntill you find the yeere o Lord wherein you seeke the declination, and dire vnder that yere is the moneth wherein you must s the Suns declination. Example, 1595. the tenth day o bruary I would knowe the Suns declination, first I lo out February, and ouer the third moneth I see the ye 1595. therefore that is my moneth, against the tenth d of which moneth I finde that the sunne hath 11. degr 10 minutes of south declination, and after the like m ner you must do in all the rest as occasion requireth.

Januar

First.		Second.			Third.			Fourth.	
2		2			3			4	
193		1594			1595			1596	Yeare of the Lord.
197		1598			1599			1600	
201		1602			1603			1604	
205		1606			1607			1608	
209		1610			1611			1612	
G.	M.	D.	G.	M.	D.	G.	M.	D.	G. M.
18	50	1	21	52	1	22	56	1	21 57
18	40	2	21	43	2	22	9	2	21 48
18	30	3	21	33	3	21	56	3	21 38
18	20	4	21	23	4	21	46	4	21 28
18	9	5	21	16	5	21	15	5	21 17
17	58	6	21	1	6	21	4	6	21 7
17	47	7	20	50	7	20	53	7	20 55
17	35	8	20	38	8	20	41	8	20 44
17	22	9	20	26	9	20	29	9	20 32
17	9	10	20	13	10	20	16	10	20 20
South declination.		11	20	0	South declination.	11	20	3	South declination. 11 20 6
16	56	12	19	47	12	19	50	12	19 53
16	43	13	19	33	13	19	36	13	19 43
16	29	14	19	19	14	19	22	14	19 25
16	14	15	19	4	15	19	8	15	19 11
15	58	16	18	49	16	18	35	16	18 56
15	42	17	18	34	17	18	38	17	18 41
15	25	18	18	19	18	18	22	18	18 26
15	8	19	18	3	19	18	7	19	18 11
14	51	20	17	46	20	17	50	20	17 54
14	32	21	17	30	21	17	34	21	17 38
14	16	22	17	13	22	17	17	22	17 21
13	57	23	16	56	23	17	0	23	17 4
13	39	24	16	38	24	16	43	24	16 47
13	21	25	16	21	25	15	25	25	16 29
13	2	26	16	3	26	16	7	26	16 12
12	43	27	15	45	27	15	49	27	15 54
12	24	28	15	26	28	15	30	28	15 35
12	4	29	15	7	29	15	12	29	15 25
11	43	30	14	48	30	14	53	30	14 58
11	24	31	14	29	31	14	34	31	14 39

February.

First.				Second.				Third.			
1				2				3			
1593				1594				1595			
1597				1598				1599			
1601				1602				1603			
1605				1606				1607			
1609				1610				1611			
D.	G.	M.		D.	G.	M.		D.	G.	M.	
1	14	4		1	14	9		1	14	14	
2	13	44		2	13	50		2	13	54	
3	13	24		3	13	29		3	13	35	
4	13	4		4	13	9		4	13	15	
5	12	44		5	12	49		5	12	54	
6	12	23		6	12	28		6	12	34	
7	12	2		7	12	15		7	12	13	
8	11	41		8	11	46		8	11	52	
9	11	20		9	11	25		9	11	31	
10	10	58	South declination.	10	11	4	South declination.	10	11	10	South declination.
11	10	37		11	10	43		11	10	48	
12	10	15		12	10	21		12	10	26	
13	9	53		13	9	59		13	10	5	
14	9	31		14	9	37		14	9	43	
15	9	9		15	9	15		15	9	21	
16	8	47		16	8	53		16	8	59	
17	8	25		17	8	30		17	8	36	
18	8	2		18	8	7		18	8	13	
19	7	36		19	7	45		19	7	51	
20	7	16		20	7	22		20	7	28	
21	6	53		21	6	59		21	7	5	
22	6	30		22	6	36		22	6	42	
23	6	7		23	6	13		23	6	19	
24	5	44		24	5	50		24	5	56	
25	5	21		25	5	27		25	5	32	
26	4	58		26	5	3		26	5	9	
27	4	34		27	4	40		27	4	46	
28	4	10		28	4	17		28	4	22	

March.

	Second.				Third.				Fourth.		
1	2				3				4		
	1594				1595				1596		
	1598				1599				1600		
	1602				1603				1604		
	1606				1607				1608		
	1610				1611				1612		
	D.	G.	M.		D.	G.	M.		D.	G.	M.
	1	3	53		1	3	59		1	3	43
	2	3	29	South-	2	3	35	South	2	3	19
South	3	3	6	declina-	3	3	12	declina-	3	2	56
declina-	4	2	42	tion.	4	2	48	tion.	4	2	32
tion.	5	2	18		5	2	25		5	2	9
	6	1	55		6	2	1		6	1	45
	7	1	31		7	1	37		7	1	22
	8	1	11		8	1	14		8	0	59
	9	0	47		9	0	50		9	0	34
	10	0	20		10	0	26		10	0	11
Equi-	11	0	3	noctia-	11	0	3	all,	11	0	12
	12	0	27		12	0	21		12	0	36
	13	0	51		13	0	44		13	0	59
	14	1	14		14	1	8		14	1	23
	15	1	37		15	1	31		15	1	46
	16	2	1		16	1	55		16	2	10
	17	2	24		17	2	18		17	2	33
	18	2	48		18	2	41		18	2	56
	19	3	11		19	3	5		19	3	20
	20	3	34		20	3	28		20	3	43
	21	3	57		21	3	53		21	4	6
	22	4	21		22	4	15		22	4	29
North	23	4	44	North	23	4	38	North	23	4	52
declina-	24	5	7	declina-	24	5	1	declina-	24	5	15
tion,	25	5	30	tion,	25	5	24	tion.	25	5	38
	26	5	52		26	5	47		26	6	1
	27	6	15		27	6	10		27	6	23
	28	6	38		28	6	32		28	6	46
	29	7	1		29	6	55		29	7	8
	30	5	23		30	7	18		30	7	30
	31	7	46		31	7	40		31	7	52

Aprill.

First.				Second.				Third.				Fourth.			
1				2				3				4			
1593				1594				1595				1596			
1597				1598				1599				1600			
1601				1602				1603				1604			
1605				1606				1607				1608			
1609				1610				1611				1612			
D.	G.	M.		D.	G.	M.		D.	G.	M.		D.	G.	M.	
1	8	13		1	8	8		1	8	10		1	7	49	
2	8	35		2	8	30		2	8	25		2	8	57	
3	8	57		3	8	52		3	8	47		3	8	12	
4	9	19		4	9	14		4	9	9		4	9	27	
5	9	41		5	9	36		5	9	30		5	9	41	
6	10	2		6	9	57		6	9	52		6	9	56	
7	10	23		7	10	18		7	10	13		7	9	9	
8	10	44		8	10	40		8	10	34		8	9	23	
9	11	5		9	11	1		9	10	55		9	9	36	
10	11	25		10	11	21		10	11	16		10	9	49	
11	11	45		11	11	42		11	11	36		11	9	2	
12	12	6	North	12	12	2	North	12	11	56	North	12	8	14	
13	12	26	declina-	13	12	22	declina-	13	12	16	declina-	13	8	26	
14	12	46	tion.	14	12	45	tion.	14	12	36	tion.	14	8	38	
15	13	6		15	13	3		15	12	56		15	8	50	
16	13	25		16	13	23		16	13	16		16	9	1	
17	13	44		17	13	42		17	13	35		17	9	13	
18	14	4		18	14	1		18	13	55		18	9	24	
19	14	22		19	14	20		19	14	14		19	9	35	
20	14	41		20	14	38		20	14	32		20	9	46	
21	14	59		21	14	58		21	14	51		21	9	57	
22	15	17		22	15	15		22	15	9		22	10	7	
23	15	35		23	15	33		23	15	27		23	10	17	
24	15	53		24	15	50		24	15	45		24	10	26	
25	16	10		25	16	8		25	16	2		25	10	35	
26	16	27		26	16	25		26	16	19		26	10	43	
27	16	44		27	16	42		27	16	36		27	10	50	
28	17	1		28	16	58		28	16	53		28	10	57	
29	17	17		29	17	9		29	17	9		29	11	3	
30	17	33		30	17	30		30	17	26		30	11	9	

May.

First.		Second.		Third.		Fourth.
1		2		3		4
		1594		1595		1596
		1598		1599		1600
		1602		1603		1604
		1606		1607		1608
		1610		1611		1612
M.	North declination.	D. G. M.	North declination.	D. G. M.	North declination.	D. G. M.
49		1 17 45		1 17 41		1 17 48
57		2 18 1		2 17 57		2 18 3
12		3 18 16		3 18 12		3 18 18
27		4 18 33		4 18 27		4 18 33
41		5 18 45		5 18 45		5 18 48
56		6 19 0		6 18 56		6 19 2
9		7 19 13		7 19 10		7 19 16
23		8 19 27		8 19 23		8 19 29
36		9 19 40		9 19 38		9 19 42
49		10 19 53		10 19 50		10 19 56
2		11 20 6		11 20 3		11 20 8
14		12 20 17		12 20 15		12 20 20
26		13 20 30		13 20 27		13 20 32
38		14 20 41		14 20 39		14 20 43
46		15 20 53		15 20 50		15 20 54
0		16 21 4		16 21 1		16 21 5
10		17 21 14		17 21 11		17 21 16
20		18 21 24		18 21 22		18 21 26
30		19 21 34		19 21 32		19 21 35
39		20 21 43		20 21 41		20 21 45
49		21 21 52		21 21 50		21 21 54
57		22 22 0		22 21 59		22 22 2
6		23 22 8		23 22 7		23 22 10
14		24 22 16		24 22 15		24 22 18
21		25 22 24		25 22 22		25 22 25
28		26 22 31		26 22 30		26 22 33
35		27 22 37		27 22 36		27 22 39
41		28 22 43		28 22 42		28 22 45
47		29 22 49		29 22 48		29 22 51
52		30 22 54		30 22 53		30 22 57
57		31 23 0		31 22 58		31 23 1

First.	Second.	Third.	Fourth.
1	2	3	4
1593	1594	1595	1596
1597	1598	1599	1600
1601	1602	1603	1604
1605	1606	1607	1608
1609	1610	1611	1612
D. G. M.	D. G. M.	D. G. M.	D. G. M.
1 23 4	1 23 4	1 23 3	1 23 2
2 23 9	2 23 8	2 23 7	2 23 6
3 23 13	3 23 12	3 23 11	3 23 10
4 23 16	4 23 16	4 23 15	4 23 14
5 23 19	5 23 19	5 23 18	5 23 18
6 23 22	6 23 21	6 23 21	6 23 21
7 23 24	7 23 23	7 23 23	7 23 23
8 23 26	8 23 25	8 23 25	8 23 25
9 23 27	9 23 26	9 23 26	9 23 26
10 23 28	10 23 27	10 23 27	10 23 27
11 23 28	11 23 28	11 23 28	11 23 28
12 23 28 North declination.	12 23 28 North declination.	12 23 28 North declination.	12 23 28 North declination.
13 23 28	13 23 28	13 23 28	13 23 28
14 23 27	14 23 27	14 23 27	14 23 27
15 23 26	15 23 26	15 23 26	15 23 26
16 23 24	16 23 23	16 23 25	16 23 24
17 23 22	17 23 23	17 23 23	17 23 22
18 23 19	18 23 20	18 23 21	18 23 20
19 23 16	19 23 17	19 23 18	19 23 17
20 23 13	20 23 14	20 23 15	20 23 14
21 23 9	21 23 10	21 23 11	21 23 10
22 23 5	22 23 6	22 23 7	22 23 6
23 23 1	23 23 2	23 23 4	23 23 2
24 22 56	24 22 57	24 22 58	24 22 58
25 22 51	25 22 52	25 22 53	25 22 53
26 22 45	26 22 46	26 22 48	26 22 48
27 22 38	27 22 40	27 22 42	27 22 42
28 22 32	28 22 34	28 22 35	28 22 35
29 22 25	29 22 27	29 22 26	29 22 28
30 22 18	30 22 20	30 22 22	30 22 22

First.		Second.			Third.			Fourth.		
1		2			3			4		
1593		1594			1595			1596		
1597		1598			1599			1600		
1601		1602			1603			1604		
1605		1606			1607			1608		
1609		1610			1611			1612		
D.	G.	M.			D.	G.	M.	D.	G.	M.
1	22	10	1	22	12	1	22	21	1	22	12
2	22	2	2	22	4	2	22	6	2	22	4
3	21	54	3	21	56	3	21	58	3	21	56
4	21	45	4	21	47	4	21	49	4	21	47
5	21	35	5	21	38	5	21	40	5	21	38
6	21	26	6	21	28	6	21	30	6	21	28
7	21	16	7	21	19	7	21	21	7	21	19
8	21	6	8	21	6	8	21	14	8	21	2
9	20	55	9	20	58	9	21	0	9	20	58
10	20	44	10	20	47	10	20	48	10	20	40
11	20	33	11	20	36	11	20	36	11	20	29
North declination.			12	20	24	12	20	26	12	20	17
			13	20	12	13	20	14	13	20	5
			14	20	0	14	20	6	14	19	52
			15	19	47	15	19	49	15	19	41
			16	19	34	16	19	36	16	19	27
			17	19	20	17	19	23	17	19	13
			18	19	7	18	19	10	18	18	59
			19	18	53	19	18	56	19	18	45
			20	18	38	20	18	43	20	18	31
			21	18	24	21	18	28	21	18	16
			22	18	9	22	18	12	22	18	1
			23	17	54	23	17	58	23	17	47
			24	17	38	24	17	42	24	17	30
			25	17	23	25	17	26	25	17	14
			26	17	6	26	17	11	26	16	58
			27	16	50	27	16	55	27	16	42
			28	16	33	28	16	38	28	16	25
			29	16	17	29	16	21	29	16	8
			30	16	0	30	16	4	30	15	51
			31	15	42	31	15	47	31	15	33

North declination.

North declination.

North declination.

August.

First.				Second.				Third.				Fourth.
1				2				3				4
1593				1594				1595				1596
1597				1598				1599				1600
1601				1602				1603				1604
1605				1606				1607				1608
1609				1610				1611				1612
D.	G.	M.		D.	G.	M.		D.	G.	M.		D.
1	15	21		1	15	25		1	15	30		1
2	15	3		2	15	7		2	15	12		2
3	14	45		3	14	49		3	14	54		3
4	14	27		4	14	31		4	14	36		4
5	14	8		5	14	12		5	14	18		5
6	14	49		6	13	53		6	13	59		6
7	13	50		7	13	34		7	13	40		7
8	13	9		8	13	15		8	13	2		8
9	13	51		9	12	56		9	13	2		9
10	13	34		10	12	36		10	12	42		10
11	12	12	North declination.	11	12	16	North declination.	11	12	23	North declination.	11
12	11	52		12	11	56		12	12	3		12
13	11	33		13	11	36		13	11	42		13
14	11	11		14	11	16		14	11	22		14
15	10	51		15	10	59		15	11	2		15
16	10	30		16	10	35		16	10	41		16
17	10	9		17	10	14		17	10	20		17
18	9	5		18	9	53		18	9	59		18
19	9	27		19	9	31		19	9	39		19
20	9	5		20	9	10		20	9	16		20
21	8	44		21	8	49		21	8	55		21
22	8	22		22	8	27		22	8	33		22
23	8	0		23	8	5		23	8	11		23
24	7	38		24	7	43		24	7	50		24
25	7	16		25	7	21		25	7	28		25
26	6	53		26	6	59		26	7	5		26
27	6	31		27	6	36		27	6	42		27
28	6	9		28	6	14		28	6	20		28
29	5	46		29	5	51		29	5	57		29
30	5	23		30	5	29		30	5	33		30
31	5	0		31	5	6		31	5	12		31

Second.				Third.				Fourth.			
2				3				4			
1594				1595				1596			
1598				1599				1600			
1602				1603				1604			
1606				1607				1608			
1610				1611				1612			
D.	G.	M.		D.	G.	M.		D.	G.	M.	
1	4	42		1	4	49		1	4	43	
2	4	20	North declination,	2	4	26	North declination.	2	4	10	
3	3	56		3	4	3		3	3	57	
4	3	33		4	3	39		4	3	34	
5	3	10		5	3	16		5	3	12	
6	2	47		6	2	53		6	2	47	
7	2	23		7	2	29		7	2	24	
8	2	0		8	2	6		8	2	1	
9	1	37		9	1	43		9	1	37	
10	1	13		10	1	19		10	1	14	
11	0	49		11	0	56		11	0	51	
12	0	26	Equi-	12	0	32	noctial.	12	0	27	
13	0	3		13	0	9		13	0	3	
14	0	21		14	0	15		14	0	20	
15	0	44		15	0	38		15	0	43	
16	1	8		16	1	2		16	1	7	
17	1	31		17	1	25		17	1	30	
18	1	55		18	1	48		18	1	54	
19	2	18		19	2	12		19	2	17	
20	2	45		20	2	35		20	2	41	
21	3	5		21	2	59		21	3	4	
22	3	28	South declination.	22	3	22	South declination.	22	3	27	South declination.
23	3	51		23	3	45		23	3	50	
24	4	15		24	4	9		24	4	14	
25	4	38		25	4	32		25	4	37	
26	5	1		26	4	55		26	5	0	
27	5	23		27	5	18		27	5	23	
28	5	46		28	5	41		28	5	46	
29	6	9		29	6	4		29	6	8	
30	6	32		30	6	26		30	6	31	

First.		Second.		Third.	
1.		2.		3.	
1593		1594		1595	
1597		1598		1599	
1601		1602		1603	
1605		1606		1607	
1609		1610		1611	
D.	G. M.	D.	G. M.	D.	G. M.
1	7 0	1	6 54	1	6 48
2	7 22	2	7 17	2	7 11
3	7 44	3	7 39	3	7 33
4	8 7	4	8 1	4	7 55
5	8 29	5	8 24	5	8 18
6	8 51	6	8 46	6	8 40
7	9 13	7	9 8	7	9 2
8	9 36	8	9 30	8	9 24
9	9 58	9	9 52	9	9 42
10	10 19	10	10 13	10	10 8
11	10 41	11	10 35	11	10 29
12	11 2	12	11 0	12	10 51
13	11 23	13	11 18	13	11 13
14	11 45	14	11 39	14	11 33
15	12 5	15	12 0	15	11 54
16	12 26	16	12 21	16	12 15
17	12 47	17	12 41	17	12 36
18	13 7	18	13 1	18	12 56
19	13 27	19	13 22	19	13 17
20	13 47	20	13 41	20	13 36
21	14 6	21	14 1	21	13 56
22	14 26	22	14 21	22	14 16
23	14 45	23	14 40	23	14 35
24	15 4	24	14 59	24	14 54
25	15 23	25	15 17	25	15 13
26	15 41	26	15 36	26	15 31
27	15 59	27	15 54	27	15 50
28	16 17	28	16 12	28	16 8
29	16 35	29	16 30	29	16 25
30	16 52	30	16 47	30	16 43
31	17 9	31	17 4	31	17 0

South declination.

South declination.

South declination.

First.		Second.			Third.			Fourth.		
1		2			3			4		
1593		1594			1595			1596		
1597		1598			1599			1600		
1601		1602			1603			1604		
1605		1606			1607			1608		
1609		1610			1611			1612		
G.	M.	D.	G.	M.	D.	G.	M.	D.	G.	M.
17	26	1	17	21	1	17	17	1	17	36
17	42	2	17	38	2	17	33	2	17	53
17	58	3	17	54	3	17	49	3	18	9
18	14	4	18	9	4	18	6	4	18	25
18	29	5	18	25	5	18	22	5	18	41
18	44	6	18	40	6	18	37	6	18	55
18	59	7	18	55	7	18	52	7	19	10
19	14	8	19	10	8	19	6	8	19	24
19	26	9	19	24	9	19	21	9	19	38
19	42	10	19	36	10	19	35	10	19	52
19	45	11	19	52	11	19	48	11	20	5
20	8	12	20	5	12	20	7	12	20	18
20	21	13	20	18	13	20	14	13	20	30
20	34	14	20	30	14	20	27	14	20	43
20	46	15	20	42	15	20	39	15	20	54
20	57	16	20	54	16	20	51	16	21	6
21	8	17	21	5	17	21	3	17	21	17
21	19	18	21	16	18	21	14	18	21	27
21	29	19	21	27	19	21	24	19	21	37
21	30	20	21	37	20	21	35	20	21	47
21	49	21	21	47	21	21	44	21	21	56
21	58	22	21	56	22	21	54	22	22	5
22	7	23	22	5	23	22	3	23	22	14
22	15	24	22	21	24	22	11	24	22	21
22	23	25	22	14	25	22	19	25	22	29
22	31	26	22	29	26	22	27	26	22	36
22	38	27	22	37	27	22	34	27	22	43
22	44	28	22	43	28	22	41	28	22	49
22	50	29	22	49	29	22	47	29	22	55
22	56	30	22	54	30	22	53	30	23	0
South declination.					South declination.			South declination.		

December.

First.			Second.			Third.			Fourth.
1			2			3			4
1593			1594			1595			
1597			1598			1599			
1601			1602			1603			
1605			1606			1607			
1609			1610			1611			
D.	G.	M.	D.	G.	M.	D.	G.	M.	D.
1	23	1	1	23	0	1	22	58	1
2	23	6	2	23	5	2	23	4	2
3	23	10	3	23	9	3	23	8	3
4	23	14	4	23	13	4	23	12	4
5	23	17	5	23	17	5	23	16	5
6	23	20	6	23	20	6	23	9	6
7	23	23	7	23	22	7	23	22	7
8	23	25	8	23	25	8	23	24	8
9	23	26	9	23	26	9	23	26	9
10	23	27	10	23	27	10	23	27	10
11	23	28	11	23	28	11	23	28	11
12	23	28	12	23	28	12	23	28	12
13	23	28	13	23	28	13	23	28	13
14	23	27	14	23	27	14	23	27	14
15	23	26	15	23	26	15	23	26	15
16	23	24	16	23	24	16	23	25	16
17	23	21	17	23	22	17	23	23	17
18	23	19	18	23	20	18	23	20	18
19	23	16	19	23	17	19	23	17	19
20	23	12	20	23	13	20	23	14	20
21	23	8	21	23	7	21	23	10	21
22	23	3	22	23	4	22	23	5	22
23	22	58	23	22	59	23	23	1	23
24	22	52	24	22	54	24	22	56	24
25	22	47	25	22	48	25	22	50	25
26	22	40	26	22	42	26	22	43	26
27	22	36	27	22	35	27	22	37	27
28	22	30	28	22	28	28	22	30	28
29	22	22	29	22	20	29	22	22	29
30	22	14	30	22	12	30	22	14	30
31	22	6	31	22	4	31	22	6	31

South declination. South declination. South declination.

What is the Chart?

The Sea Chart is a speciall instrument for the Seamans vse, whereby the Hydrographicall description of the Occean Seas, with the antipodographicall limits of the earth, are supposed to be in such sort given as the longitude and latitude of all places, with the true distance and bearing betweene place and place might thereby be truely knowne. But because there is no proportionable agreement betweene a Globus superficies and plaine superficies, therefore a Chart doth not expresse that certainty of Leagues which is thereby pretended to be given, for things are best described upon bodies agreeable to their owne forme. And whereas in the true Globe of the Sphere there can be no parallells described but the East and West courses onely, the rest of the courses being concurred lines, ascendent unto the Poles, the Meridians all concurring and joyning together in the Poles, notwithstanding in the Sea Chart all those courses are described as parallells, without any diuersity, alteration, or distinction to the contrarie, whereby the instrument is apparantly faultie: yet it cannot be denyed but that for short courses are to very good purpose for the Pilots vse, and in such courses be the distance neuer so farre if the Pilot returne by the same way whereby in the first he prosecuted his voyage, his Chart will be without error, as an instrument of very great commodity: but if he returne by another way, then by that which hee went forth, the imperfections of the Chart will then appeare to be very great, especially if the voyage be long, or the same be in the North partes of the worlde, the farther towards the Pole, the more imperfect: therefore there is no instrument answerable to the Globe or paradoxall Chart, for all courses and climats whatsoeuer, by which all desired truth is most plentifully manifested, as shall hereafter at large be declared: but for the coasting of any shore or country, or for short voyages, there is no instrument more conuenient for the Seamans vse, then a well described Sea Chart.

What is the vse of the Sea Chart?

By the directions of the sea chart the skilfull pilot conuaieth his ship from place to place, by such courses as by the chart are made known vnto him together with the helpe of his Compasse or Crosse staffe as before is shewed, the Crosse staffe, the Compas, and the Chart, are so necessarily ioined together, as that the one may not well be without the other, in the execution of practises of Nauigation: for as the Chart sheweth the courses, so doth the Compasse direct the same, and the Crosse staffe by euery particular observed

altitude doth confirme the truth of such courses, and also giueth the certaine distance that the Ship hath sayled vpon the same.

And in the vse or vnderstanding of the Sea Chart there are fiue things chiefely to be regarded.

The first is, that the Countries or geographie of the Chart be knowne with euery Cape, Promontory, Port, Hauen, Bay, Sands, Rocks, and dangers therein contayned.

Secondly, that the lines drawne vpon the Chart, with there seuerall properties be likewise vnderstood.

Thirdly, that the latitudes of such places as are within the Chart be knowne, as by the Chart they are expressed.

Fourthly, that you be able to measure the distances betweene place and place vpon the Chart.

And fiftly, the Seaman must be able by his Chart to know the true courses betweene any Iles, continents, or Capes whatsoeuer, for by the diuersities, the Chart is to be vsed in the skill of Nauigation.

How is the latitude of places knowne by the Chart?

THe latitude is thus found by the Chart, vpon the place whose latitude you desire to know, set one foot of your compasses, then stretch the other foote to the next East and West line (for that line is your direction) keeping that foote still vpon the same line, moue your hand and Compasses East or West as occasion requireth, vntill you bring the Compasses to the graduated Meridian, and there that foote of the Compasses which stode vpon the place whose latitude you would know, doeth shewe the latitude of the same place.

How is the course betweene place and place knowne?

WHen there are two places assigned, the course betweene which you desire to know, set one foote of your Compasses vpon one of the places, then by discretion consider the lines that lead to ward the other place, stretching the other foote of the Compasses to one of those lines, and to that part of the line which is neerest to you, keeping that foote still vpon the same line, moue your hand and Compasses to ward the other place, and see whether the other foote of the Compasses that stod vpon the first place, doe by discretion touch the second place, which if it doe, then that line whereupon you kept the one foote of your Compasses, is the course betweene those places: but if it touch not the place, you must by discretion search vntill you finde the line, whereupon keeping the one foote of the Compasses, will lead the

directly from the one place to the other, for that is the course betweene these two places.

How is the distance of places found vpon the Chart?

If the places be not farre asunder, stretch a paire of Compasses betweene them, setting the one foote of the compasses vpon one of the places, and the other vpon the other place, then not altering the compasses, set them vpon the mentioned Meridian of your Chart, and allowing 20. leages for euery degree that is contained betweene the 2. feet of your Compasses, the distance desired is thereby knowne: if betweene the places there be 5. degrees, then they are 100. leages asunder, &c. But if the distance betweene the places be so great, that the compasses cannot reach betweene them, then take out 5. degrees with your compasses which is 100. leages, and therewith you may measure the distance as practise will teach you. There is also in euery Chart a scale of leages laid downe, whereby you may measure distances, as commonly is [illegible]

How doth the Pilote order these matters, thereby to conduct his Ship from place to place.

The Pilote in the execution of this parte of Nauigation, doth with carefull regarde consider three especiall thinges, whereupon the full practise is grounded.

Of which the first is, the good obseruation of his latitude which howe it may be knowne is before sufficiently expressed.

The second is a carefull regarde vnto his steredge, with very diligent examination of the truth of his Compasse, that it be without variation or other impediments.

And the third is a carefull consideration of the number of leags that the Ship sayleth in euery houre or watch, to the neerest estimation that possibly it can giue, for any two of these three practises being truely giuen, the third is thereby like wise knowne.

As by the Corse and height the distance is manifested, by the distance and Corse the height is known: by the height and distance the Corse is giuen, of which 3. thinges the Pilote hath onely his height in certaintie: the corse is somewhat doubtful, and the distance is but barely supposed, notwithstanding [illegible] altitude and corse hee concludeth the truth of his practise, proceeding in this sort.

First he considereth in what latitude the place standeth from whence hee [illegible] his corse, which for an example shalbe the Lyzart standing in 50. de-

grees of septentrionall latitude, then directing his corse S. W. sa[illegible] daies or longer in such thick weather, as that he is not able to [illegible] seruation of the Poles altitude, in which time he omitteth not [illegible] accompt how many leags the ship hath sailed vpon that corse as [illegible] can gesse, which number of leages in this example shalbe 100. [illegible] his iudgement: then hauing conuenient weather, he obserueth [illegible] titude he is, and findeth himselfe to be in 47. degrées, now [illegible] passes he taketh the distance of 100. leages, which is the [illegible] Ships run by his supposition, and then setting one foote of the [illegible] vpon the Lizart, which is the place from whence he began his [illegible] rectly S. W. from the same he setteth the other point of the [illegible] the direction of another paire of compasses, in such sort as corses [illegible] and there he maketh a prick for the place of his ships being, [illegible] reconing and Corse.

And now searching whether it doe agree with his height, (for [illegible] corse, and distance must all agree together) he findeth that his [illegible] in 46. degrées, 29. minutes, but it should stand in 47. degrees, to [illegible] his obseruation. Therefore perceiuing that he hath giuen the [illegible] way, he bringeth his corse and obserued altitude to agree, and [illegible] that his ship hath sayled but 85. leages, and there he laieth down [illegible] the true place of his ships being, according to his corse and latitude [illegible] his corse and height he findeth the truth of his distance, and [illegible] supposed accompt to be 15. leags too much; and after this sort he [illegible] from place to place, vntill he ariue vnto his desired porte: which [illegible] sion infallible if there be no other impediments, (wherof there [illegible] good consideration had) which may breede errour, for from such [illegible] there may arise many inconueniences.

What may those impediments be?

By experience at the Sea we find many impediments that [illegible] expected conclusion of our practises, as that they agree not [illegible] positions of arte. For, first it is a matter not common to [illegible] beneficial, as that a ship may saile thereby, betwen any two [illegible] vpon the direct corse, but that by the contrarietie of windes, [illegible] strained to trauers vpon all points of the Compasse, (the [illegible] I haue before sufficiently expressed.

Secondly, although the winde may in some sort [illegible] haue such a leward condition, as that she may make her [illegible] from her caping.

Thirdly, the steredge may be so disorderly handled [illegible]

may be abused.
lastly, the compasse may be so varied, as that the Pilote may likewise be drawn into errour, of all which things and many moe, as the na- his sayling, whether before the winde, quartering, or by a bowling, or with lofty or low sailes, with the benefits or hinderances of the sea, streames, and forced set thereof, &c. Of all which things (I say) Pylote must haue carefull consideration, which are better lear- praise then taught by penne, for it is not possible that any man can and sufficient pylot or skilful Seaman, but by painful and diligent with the assistance of arte, whereby the famous Pylot may be este- his profession, as a member meete for the common weale.
having sufficiently shewed you the ordering of your Chart, for of the skill of Navigation, and being also desirous that you effectually understand the full nature and vse of the same. I thinke it questions to give you an occasion to exercise your selfe in the accomplishment of such conclusions as are by this excellent and com- instrument to be performed.

Necessary questions for the better vnderstanding of the commodious vse of the Chart.

Q. If I sayle 70. leages vpon the Southwest course, I demaund how degrees I shall lay or depresse the Pole?
A. The difference wilbe 2. degrees, 30. minutes.
Q. If in sayling West Norwest I raise the Pole 3. degrees, 30. mi- demaund how many leages I haue sayled?
A. The distance sayled, is 180. leages.
Q. If in sayling 108. leages betwéen West and Nor, I raise the Pole degrees, I demaund vpon what corse I haue sailed, and how farre I am the Meridian from whence I began that corse?
A. The corse sailed is N. w. b. W. and the distance from the Meridian leages.
Q. If in sayling 154. leages I be 80 leages West from the Meridian whence I began my corse, I demaund vpon what point of the Compas sayled, and how much I haue raised the Pole?
A. The corse is N w, b. N. and the Pole is raised 6. degrees.
Q. If I saile N w. vntill I be 50. leags from tho Meridian where I be- my Corse, I demaund how many leages I haue sayled, and how much Pole is raised?
A. The distance sailed is 71. leages, and the Pole is raised 2. degrees, minutes.

6 Q. If in sayling W. N. W. I doe in 30. howers raise 2. degrees, how many degrees should I haue raised the Pole, if the same motion had been North and by West?

A. You should haue raised 5. degrees.

7 Q. A Ship sayling towards the West, for euery 80. leages that she saileth in her Course, she departeth from the Meridian from whence she began the same Course 45. leags, I demaund vpon what point of the Compasse how many leages she hath sayled, in rayling the Pole 5. degrees?

A. She hath sayled Northwest by North 120. leagues.

8 Q. A Pylote sayling toward the West 100. leages, hath forgotten his Course, yet thus much he knoweth, that if he had sailed vpon such a Course that in 100. leages sayling hee should haue raysed the Pole 3. degrees, he should then haue bene twise as farre from the Meridian as now he is, and should also haue bene 1. degree further to the Northward then now he is. I would now know what Course he hath sailed, how many leages, and how farre hee is seperated from the Meridian from whence he began his Course.

A. Shee hath sayled 88. leages Northwest by west, and is 73. leages from the Meridian Westerly.

9 Q. Two Ships departing from one place, the one sayling 145. leages towards the west, hath rayled the Pole 4. degrees, and the other hath rayled the Pole 7. degrees, and is 95. leages West from the Meridian from whence he began his Course. I demaund by what Course the one hath sailed, how farre they be asunder, and by what Course they may meete?

A. The first ship hath sayled Northwest by west, the second Northwest by North, 170. leages, they are asunder 65. leages, and the Course betweene them is North northeast, and South southwest.

10 Q. Two ships sayling from one place, the one in sayling 180. leages to the Eastwarde of the Meridian where he began his Course 150. leages, demaund vpon what Course and how many leages the other ship shall be lying himselfe 50. leages N. b. W. from the first ship?

A. The first Ship hath sailed N. e. b. e. and hath rayled the Pole 5. degrees, the second ship must saile Northeast by North 237. leages.

Lthough it may ſeeme (to ſome that are very expert in Nauigation) that theſe queſtions are needleſſe, and without vſe, being ſo plaine as not deſeruing in this ſort to bee liſhed, notwithſtanding that their opinion, I do in dly curteſie aduiſe all young practiſers of this excelarte of ſayling, that they doe not onely by their ts prooue the truth of theſe anſwered queſtions, lſo indeuour themſelues to propound diuers other of queſtions, and in ſeeking their anſweres, to enro the reaſon thereof: for by ſuch exerciſe, the beginner ſhall vnderſtand the ſubſtantial grounds Chart, and grow perfect therein: for whoſe eaſe furderance onely, I haue at this preſent publiſhed briefe treatiſe of Nauigation, knowing that the exPylote is not vnfurniſhed of theſe principles, but little helpe dooth greatly further in euery beginand therefore for the further benifite of the prachaue hereunto annexed a perticular Sea Chart of Channell, commonly called the Sleue, by which all before ſpoken as touching the vſe of the Chart, y be practiſed, wherin the depths of the Chanell are ely layde downe: being an inſtrument moſt comodious and neceſſary for all ſuch as ſeeke the chanell inning out of the ocean Sea, much of it is from my wne practiſe, the reſt from pylotes of very good ſufiencie: I haue founde great certaintie by the vſe of his Chart, for by the altitude and depth I haue not at o time miſſed the true notice of my Shippes being,

6 Q. If in sayling W. N. W. I doe in 30. howers raise 2. degr[illegible] many degrées should I haue raised the Pole, if the same motion [illegible] North and by West?

A. You should haue raised 5. degrées.

7 Q. A Ship sayling towards the West, for euery 80. leages th[illegible] leth in her Corse, she departeth from the Meridian from whence [illegible] the same Corse 45. leags, I demaund vpon what point of the Co[illegible] how many leages she hath sayled, in raysing the Pole 5. degrées?

A. She hath sayled Northwest by North 120. leages.

8 Q. A Pylote sayling toward the West 100. leages, hath forg[illegible] Corse, yet thus much he knoweth, that if he had sailed vpon such a C[illegible] that in 160. leages sayling hee should haue raysed the Pole 3. degr[illegible] should then haue béene twise as farre from the Meridian as now he [illegible] should also haue béene ½ degrée further to the Northward, then [illegible] I would now know what Corse he hath sailed, how many leages [illegible] farre hee is seperated from the Meridian from whence he began [illegible] Corse.

A. Shee hath sayled 88. leages Northwest by west, and is 73. [illegible] from the Meridian néerest.

9 Q. Two Ships departing from one place, the one sayling 145. [illegible] towards the west, hath raised the Pole 4. degrees, and the other ha[illegible] the Pole 7. degrees, and is 95. leages West from the Meridian [illegible] from whence he began his corse, I demaund by what corse the [illegible] sailed, how farre they be asunder, and by what corse they may [illegible]

A. The first ship hath sayled Northwest by west, the second [illegible] Northwest by north, 170. leags, they are asunder 65. leags, and the [illegible] twéene them is North northeast, and South southwest.

10 Q. Two ships sayling from one place, the one in sayling 180. [illegible] to the Eastwarde of the Meridian where he began his corse 150. [illegible] demaund vpon what corse and how many leages the other ship [illegible] bring himselfe 50. leages N. b. W. from the first ship?

A. The first Ship hath sailed N. e. b. e. and hath raysed the Pole [illegible] grées, the second ship must saile Northeast by north 237. leages.

ALthough it may ſeeme (to ſome that are very expert in Nauigation) that theſe queſtions are needleſſe, and without vſe, being ſo plaine as not deſeruing in this ſort to bee iſhed, notwithſtanding that their opinion, I do in dly curteſie aduiſe all young practiſers of this excelarte of ſayling, that they doe not onely by their rs prooue the truth of theſe anſwered queſtions, lſo indeuour themſelues to propound diuers other s of queſtions, and in ſeeking their anſweres, to ento the reaſon thereof: for by ſuch exerciſe, the beginner ſhall vnderſtand the ſubſtantial grounds s Chart, and grow perfect therein: for whoſe eaſe furderance onely, I haue at this preſent publiſhed eſe treatiſe of Nauigation, knowing that the exPylote is not vnfurniſhed of theſe principles, but little helpe dooth greatly further in euery beginand therefore for the further benifite of the prac- I haue hereunto annexed a perticular Sea Chart of Channell, commonly called the Sleue, by which all before ſpoken as touching the vſe of the Chart, be practiſed, wherin the depths of the Chanell are ly layde downe: being an inſtrument moſt comodious and neceſſary for all ſuch as ſeeke the chanell ming out of the ocean Sea, much of it is from my wne practiſe, the reſt from pylotes of very good ſufencie: I haue founde great certaintie by the vſe of s Chart, for by the altitude and depth I haue not at time miſſed the true notice of my Shippes being,

which (through Gods mercifull fauour) by my
falls I haue found alwayes to be without errour,
fore haue it not in light regard, for it will giue you
euidence, and is worthy to be kept as a ſpecial iewe
the Seamans vſe, be he neuer ſo expert.

And thus hauing ſufficiently expreſſed all the p
ſes appertayning to the skill of Horizontal Nauig
which kinde of ſayling is now of the greateſt ſor
practiſed, I think it good for your better memory
fly to reporte that which before is ſpoken as touch
this kinde of Nauigation, and with all it will not
miſſe to ſhew you after what ſorte I haue beene
ſtomed to keepe my accomptes in my practiſes of
ling, which you ſhall finde to be very ſure, plaine,
eaſie: whereby you may at all times examine wha
paſt, and ſo reforme the corſes layde downe vpon
Chart, if by chaunce there ſhould any errour be co
mitted. And ſo concluding this parte of Nauig
will in the next treatiſe make knowne vnto you
vſe of the Globe, ſuch vſes I meane as the Seaman m
practiſe in his voyages, and that are moſt neceſſary f
his knowledge.

Table shewing the order how the Seaman may keepe his accompts, wherby he may at all times distinctly examine his former practises for every 24. howers, which is from noone to noone, he doth not onely lay [illegible] his latitude, with the corse and leages, but also how the wind hath [illegible] in the same time.

The first Colume is the moneths and daies of the same, the second is [illegible] observed altitude, the third is the Horizontall corse or motion of the [illegible] the fourth the number of leages that the Ship hath sayled, the fifth [illegible] space wherein must be noted, by what wind those thinges haue beene [illegible] formed: and the next great space is to lay downe any breefe discourse [illegible] memory.

Anno. 1593.

[illegible] and [illegible] of the [illegible]	Latitude. G.	M.	Corse.	Leages	Winde	The 23. of March, cape S. Augustine in Brasill, being 16. leags east from me, I began this accompt.
24	7	30	N.N.E.	25	East.	
25	5	44	N.b.E, norly	36	E.b.N	Compasse varied 9. deg. the South point westward.
26	4	1	N.b.N.	35	E.b.N.	Compasse varied 8. deg. the South point westward.
27	2	49	N.	24	E.b.N.	
28	1	31	N. esterly.	26	E.b.N.	
29	1	4	N.N.W.	9	N.E.	Compasse varied 6. deg. [illegible] the South point westward.
31	0	0	N.b.W.	21	E.N.E.	Observation, the Pole [illegible] the Horizon.
4	0	39	N.W.b.N.	15	N.E.	
7	1	53	N.N.W.	28	N.E.	
9	3	5	N.W.b.N.	30	N.e.b.e.	
10	4	5	N.W.b.N.	22	N.e.	
11	4	45	N.W.	18	N.e.b.N.	
12	5	16	N.W.	14	N.e.b.N.	
13	6	11	N.W.b.N.	23	N.e.	
14	7	16	N.w.b.N.	24	N.e.	Compasse varied 7. deg. the [illegible] point eastward.

A breefe repetition of that which is before spoken.

There are 3. kindes of Nauigation, Horizontall, Paradorall, and vpon a great Circle, performed by Corse and trauers.

A Corse is the paradorall line, which is described by the Ship vpon any point of Compasse.

A Trauers is the varietie of the Ships motion vpon euery alteration of Corses.

The Compasse is an artificiall Horizon, by which Corses and Trauers are directed, and containeth 32. pointes, and euery point containeth 11. degrees, 15. minutes, being ¼ of an howre.

By such quantitie of time as the Moone seperateth her selfe from the Sunne, by the like rate of time euery tide doth one differ from another.

In euery howre the tide altereth two minutes, in euery flud two minutes, and in euery ebbe twelue minutes, and in euery day 48. minutes: cause that is the Moones seperation from the Sunne: for she doth seperate herselfe from the Sunne, in euery day one point 48. minutes, betweene the chang and the full she is to the East wards of the Sunne, and then is her seperation, at which time she is before the Sunne in respect of her naturall motion, but in regarde of her violent motion, she is behinde or abaft the Sunne.

Betweene the full and the change, she is to the Westward of the Sunne, applying towards the Sun, and then is her application, at which time she is behinde or abaft the Sunne, in respect of her natural motion, but in consideration of her violent motion, she is then before the Sunne.

She hath a violent motion, a naturall motion, a slow swifte and a meane motion.

In euery 27. daies and 8. howers she performeth her naturall course through the Zodiac.

Betweene chang and change there is twenty nine daies, fiue houres fourty foure minutes neere.

The solar yeer consisteth of 12. months, and the lunar yeer of 12.

The Moones age is found by the Epact.

All instruments vsed in Nauigation, of what shape or forme soeuer they be, are described or demonstrated vpon a Circle, or some portion of a Circle, and therefore are of the nature of a Circle.

A degree is the 360. parte of a Circle, how bigge or little soeuer the Circle be.

A degree is applied after 6. seuerall sortes, to the Equator, to the Ecliptique, to the Horizon, to the verticall Circle, to measure, to time.

Altitude is the distance, height, or mounting of one thing above another.

The Poles altitude is the distance betweene the Pole and the Horizon.

portion of the Meridian which is contained betwéen the Pole and
rizon.
altitude of the Sunne aboue the Horizon, is that portion of the ver-
circle, which is contained betwéen the Horizon and the Sunne.
itude is that arke of the Meridian which is contained betwéene the
ll of any place and the Equator, or that part of the Meridian which
ded betwéen the Zenith and the Equinoctiall.
gitude is that portion of the Equator contained betwéen the Meri-
S. Mihels, one the Iles of the Assores, and the Meridian of the place
longitude is desired: the reason why the accompt of longitude doth
at this Ile, is, because that there the Compasse hath no variety, for the
an of this Ile passeth by the Poles of the worlde and the Poles of the
, being a Meridian proper to both Poles.
longitude betwéen place and place, is the portion of the Equator
is contained betwéen the Meridians of the same places.
ation is the distance of the sunne, Moone and Starres, from the
uctiall, or that part of the Meridian which passeth by the Center of
estriall body, and is contained betweene the same center and the
uctiall.
ography is the description of the Ocean Sea, with all Iles, banckes,
and sands therein contained, whose limits extend to the geographicall
of the earth, the perfect notice whereof is the cheifest thing required
cient Pylote, in his excellent practise of sayling.
graphy is the description of the earth onely, whereby the terrestriall
in his due situation is giuen, whose distinction is by mountaines, ri-
ballis, cities, and places of fame, without regarde of Circles, Cly-
and Zones.
mography is the description of the heauens, with all that is contai-
in the circuit thereof, but to the purpose of nauigation, we must vn-
Cosmography to be the vniuersall description of the terrestriall
, distinguished by all such circles, by which the distinction of the cele-
here is vnderstoode to be giuen, with euery Country, Coast, Sea
, or other place, seated in their due longitude, latitude, Zone,
Clyme.
Chart is a speciall instrument in Nauigation, pretending the Cos-
icall description of the terrestriall Globe, by all such lynes, circles,
and diuisions as are required to the most exquisite skill of nauigation.

The end of the First Booke.

[illegible] of the Meridian which is contained between the Pole and [illegible]

[illegible] the Equator, is that portion of the [illegible] [illegible] the Horizon and the Sunne.

[illegible] the Meridian which is contained between the [illegible] and the Equator, or that part of the Meridian which [illegible] between the Zenith and the Equinoctiall.

[illegible] that portion of the Equator contained between the Meridian [illegible] one the Iles of the Alfores, and the Meridian of the place [illegible] is [illegible] the reason why the accompt of longitude both [illegible] the Iles, is, because that there the Compasse hath no variety, for the [illegible] is [illegible] by the Poles of the worlde and the Poles of the [illegible] Meridian proper to both Poles.

[illegible] between place and place, is the portion of the Equator [illegible] contained between the Meridians of the same places.

[illegible] is the distance of the sunne, Moone and Starres, from the [illegible], or that part of the Meridian which passeth by the Center of [illegible] body, and is contained between the sunne center and the [illegible].

[illegible] is the description of the Ocean Sea, with all Iles, bancques, [illegible] therein contained, whose limits extend to the geographicall [illegible] the earth, the perfect notice whereof is the chiefest thing required [illegible] Pylote, in his excellent practise of sailing.

[illegible] is the description of the earth onely, whereby the terrestriall [illegible] due situation is given, whose distinction is by mountaines, ri[illegible], cities, and places of fame, without regarde of Circles, Cly[illegible] Zones.

[illegible] is the description of the heavens, with all that is contai[illegible] the circuit thereof, but to the purpose of navigation, we must en[illegible] Cosmography to be the universall description of the terrestriall [illegible] distinguished by all such circles, by which the distination of the cele[illegible] is [illegible] to be given, with every Country, Coast, Sea [illegible] other place, [illegible] in their due longitude, latitude, Zone, [illegible]

[illegible] is a special instrument in Navigation, pretending the Co[illegible] description of the terrestriall Globe, by all such lines, circles, [illegible] divisions as are required to the most exquisite skill of navigation.

The end of the First Booke.

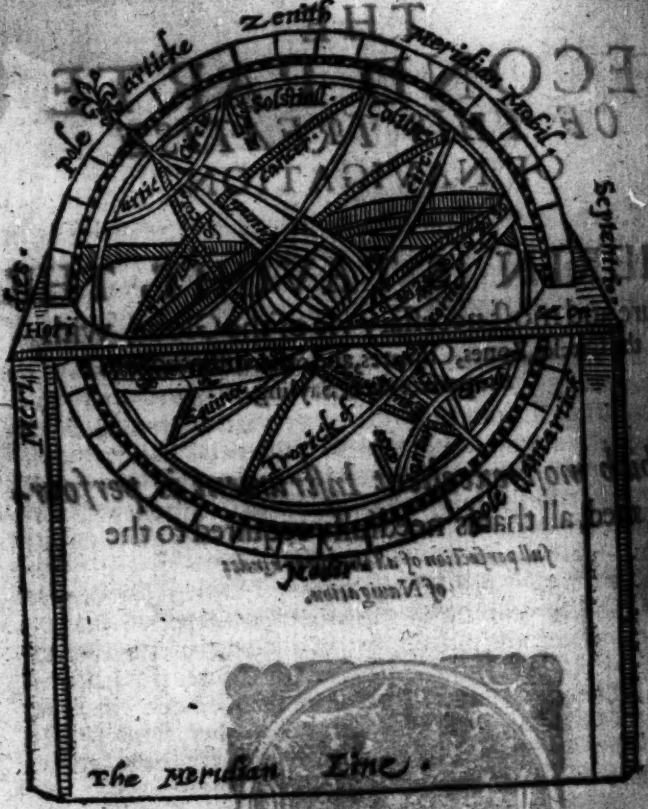
THE SECOND PARTE OF THIS TREATISE OF NAVIGATION.

WHERIN IS TAVGHT, THE

nature and most necessary vse of the Globe, with the Circles, Zones, Climates, and other distinctions to the perfect vse of Sayling.

which most excellent Instrument is perfour-

med, all that is needfully required to the *full perfection of all the three kindes of Navigation.*



The Meridian Line.

THE SECOND BOOKE OF THE SEAMANS SECRETS.

What is the Sphere?

The Sphere is a solide body, contayned vnder one superficies, in the midst whereof there is a point or prick, which is the Center of the Sphere, from whence all right lines drawn to the circumference, are equal the one to the other, whereby it is to be vnderstand that the centre of the Sphere is so euenly placed in his midst, as that it [illegible] distance from all parts of the Circumference. And forasmuch as the [illegible] is an instrument demonstrating vnto vs the vniuersal engine of the [illegible] we must therfore vnderstand this center to be this terrestrial Globe, [illegible] we haue our being, which compared to the celestiall Globe or [illegible] [illegible] both bear proportion, as ẏ center to his circle: which earth [illegible] the diuine maightie workmanship of God, doth [illegible] being [illegible] center, being of equall distance from all parts of the circumference.

What are the distinctions of the Sphere?

The Sphere is distinguished by tenne circles, whereof sixe are great circles, and 4. are lesser circles: whereof there are onely 8. described [illegible] body of the Globe, limitting the zones and motion of the Planets, [illegible] Equinoctiall, the Ecliptick, the Equinoctiall Colure, the Solsticiall [illegible], the Tropick of Cancer, the Tropick of Capricorne, the Artick [illegible] Circle, and the Antartick Polar Circle. The Horizon and Meridian [illegible] described vpon the body of the Globe, but artificially annexed [illegible] for the better perfection of his vse.

Which are the great Circles, and which the lesser?

The Equator, the Ecliptick, the 2. Colures, the Meridian and the Horizon are great circles, because they deuide the sphere into 2. equal parts. The 2. Tropicks, the 2. Polar circles, are lesser circles, because they deuide the sphere into 2. vnequall partes.

What is the Equator or Equinoctiall?

The Equinoctial is a great circle deuiding ẏ Sphere into 2. equal parts, [illegible] the one halfe towards the North, and the other halfe to [illegible] [illegible], and is equally distant from both the Poles of the [illegible] 90. degrees,

grees, placed euenly betweene them, and described vpon them, this line cro-
seth the Horizon in the true points of East and West, and hath alwaies
own halfe aboue the Horizon, vnles it be vnder either of the Poles, for
the Equator is in the Horizon: it crosseth the Meridian at right Spher-
angels, and it also crosseth the Ecliptick line in the first minute of Aries
Libra, deuiding the Ecliptick and Horizon, and is also by them deuided
two equall parter. This line is also deuided into 360. equall partes
grees, which are the degrees of Longitude, beginning the account in
point of Aries, reckoning towards the East, concluding the number 360.
the place where the first account began: viz, where the Equator doth in-
secte the Ecliptick in the first minute of Aries, vnder which Meridian S.
Michels one of the yls of the Azores to be placed in the geographical descr-
tion of the terrestriall Globe.

What is the vse of the Equator?

THe vse of the Equinoctiall, is to knowe the declination of the Sunne, Mone and Stars, whereby the latitude of places is giuen, for that
tion of the Meridian which is contayned betweene the Equator and
Center of the Sunne, Mone or Starres, is their declination: also by
Equinoctiall is knowne the Longitude of places, for a quarter of a
Circle being drawne from the Pole, to the place whose Longitude is
red, and so continued to the Equinoctiall, that degree and minute in
the quarter Circle doeth touch the Equator, is the Longitude of the
place, or if you bring any place (that is described vpon the Globe) whose
gitude you would know, vnder the Meridian of the Globe, that degr
the Equinoctiall that is then likewise directed vnder the Meridian
Longitude desired. When the Sunne commeth vpon the Equator, then
dates and nights are of one length through the whole worlde: and
Sunne riseth vpon the true point of East, and setteth vpon the true
West, and not els at any time. This circle being fired in the firmament,
moued with the first mouet in euery houre 15. degrees, by which accompt
24. howers his motion is performed. And here note, that the degrees of
Equinoctiall haue a double application, the one to time, and the other to
sure: in respect of time 15. degrees make an houre, so that euery deg
contayneth but 4. minutes of time, but when his degrees haue relation
measure, then euery degree containeth 60. minutes, being 20. leags, so
euery minute standeth for a mile after our English accompt.

But this allowance of 20. leags to euery degree of the Equinoctiall, in
sayling, or measuring of distances vpon the East and West Coastes, is on
ly when you are vnder the same, because the Equinoctiall being a paral
is likewise a great circle, and euery degree of a great circle is truly ac
ted for 20. leages, or 60. myles.

But in the rest of the parallells where either of the Poles are eleuated a-
the Horizon, if there you saile or measure vpon ẏ Corses of east or west,
are not 20. leages to be allowed to euery degree, because such paral-
are lesser circles, therefore they haue the fewer number of leages to e-
degree: so that the further you depart from the Equator, the lesser are
parallells, and the lesser that any parallell is, the lesser are his degrees,
euery circle contayneth 360. degrees, and as the circles and degrees
deminished in their quantitie, in like sort the distance answerable to such
es, must abate, as their circles do decrease. And further know, that the
ator, is the beginning of all terrestriall Latitude, and declination of the
iall bodies.

What is the Ecliptick?

The Ecliptick line is a great circle, deuiding the Sphere into 2. equall
partes, by crossing the Equator in oblique sort deuiding him, and being
by him into 2. equall parts, bending from the Equator towards the
and South 23. degrees, and 28. minutes, being in the first minute
cer and Capricorne, there determining the Tropicall limits, this line
deuideth the Zodiac, by longitude into 2. equall partes, and is de-
together with the Zodiac, into 12. equall portions called signes, and
of these signes is deuided vpon the Ecliptick into 30. equall partes or
so that this line is deuided into 360. degrees, vpon which line the cen-
the Sunne doth continually moue: this circle is described vpon his
poles, named the Pole of the Zodiac, being in all his partes 90. de-
from either of them.

The Zodiac is a circle contrary to all the other, for they are mathemati-
es, consisting only of length, without breadth or thicknes: but the Zo-
th latitude or bredth 12. degrees, whose limits are 6. degrees, of either
the Ecliptick, wherein the Sun, Moone and Planets performe their
ns and reuolutions, the center of the Sunne onelye keeping vpon the
ick, but the other Planets haue sometime North latitude, and some-
South latitude. And here you must vnderstand, that the latitude of the
ts or Starres, is that portion of the Eclipticall Meridian which is
ned betweene the center of the Planet or Star and the Ecliptick line,
their longitude is that portion of the line Ecliptick, which is contained
eene the said Meridian and the Eclipticall Meridian that passeth by the
s of the Zodiac and the first minute of Aries.

The 12. deuisions or signes of the Zodiac are these, Aries ♈, Taurus ♉,
ini ♊, Cancer ♋, Leo ♌, Virgo ♍, Libra ♎, Scorpio ♏, Sagitari ♐,
corne ♑, Aquarius ♒, Pisces ♓: and these are their characters that
by them.

The 7. Planets that keepe within the limits of the Zodiac are these:

Saturne ♄, Jupiter, ♃, Mars ♂, Sol, ☉, Venus ♀, Mercury ☿, Luna ☽: the
turne perfourmes his course through all the degrees of the Zodiac, once
nery 30. yeeres: Jupiter in 12. yeeres, Mars in 2. yeeres, the
365. dayes and 6. houres being one yeere, Venus and ☿ as the Sunne
the Mone perfoꝛmeth her course in 27. dayes and about 8. houres,
all the degrées of the Zodiac.

And note that this natural motion of the Planets in the Zodiac, is
the West to ward the East, the diurnall motion is violent, caused by
first mouer, oꝛ primum mobile, who in euery 24. houres doth perfoꝛme
circular motion from the East to the West, carrying with him all othe
riour bodies whatsoeuer.

What is the vse of the Zodiac?

By the Zodiac and Ecliptick is knowne the Longitude and Latitude
any Celestiall body, either Planets oꝛ fixed Starres, foꝛ a quarter
great circle dꝛawne from the pole of the Zodiac to the center of any
oꝛ Star, and so continued vntill it touch the Ecliptick, that degrée and
nute where the said quarter circle toucheth the Ecliptick, is the longitu
the said body, which is to be accompted from the first minute of Aries
longitude of Aries is the poꝛtion of the Ecliptick line, which is cont
betweene the eclipticall meridian passing by the poles of the Zodiac
first minute of Aries, and the eclipticall meridian which passeth by the
of the Zodiac and the center of any Planet oꝛ Starre.

When the Planets are vpon the Noꝛth side of the Ecliptick, they
Noꝛth latitude, and being South from the Ecliptick, they have
latitude.

Also the motions of the Planets, the time of any Eclipse, and the
declination by his place in the Ecliptick, are knowen by this circle,
is very ample and to great purpose, foꝛ all Astronomicall consideration

What are the Colures?

The Solsticiall Colure is a great circle passing by the Poles
woꝛld, and the poles of the Zodiac, and the Solsticial points oꝛ first
nute of ♈ and ♑, cutting the Equinoctiall at right Spherick angles,
90. and in his 270. degrées.

The Equinoctiall Colure is likewise a great circle passing by the p
of the woꝛlde, and the equinoctiall point of ♈ and ♎, and crosseth the eq
toꝛ in his first and 180. degrées, and those Colures doe interseat each o
in the poles of the woꝛld to the right spherick angles.

What is the vse of these Colures?

Their vse is to distinguish the 4. pꝛincipall seasons of the yeare, Spri
Summer, Autumne, and winter, deuiding the Equatoꝛ and Eclip
into 4. equall parts; also that arke of the Solsticiall Colure which is

betwéene the first minute of ♋ and the Equinoctiall, is the Sunnes
est declination toward the North, the like arke being betwéene the
all point of ♑ and the Equator, is the Sunnes greatest South decli-
on, being in these our daies 23. degrées, 28. minutes.

What is the tropick of Cancer?

The Tropick of ♋ is one of the lesser circles deuiding the sphere into
two vnequall parts, and is described vpon the pole Artick, a parallell to
Equator 23. degrées 28 minutes from him, being the farthest limit of
Ecliptick bending towards the North, to which when the Sunne com-
, the daies are then longest to all those that inhabit in the North partes
the worlde, and shortest to the Southerne inhabitantes: betwéene this
and the Equator are included the 6. septentrionall signes, ♈, ♉, ♊, ♋,
♌, ♍, which signes during the time that the Sunne abideth, being from
the of March, to the 13. of September, he hath North declination, and
is the lying and Summer to all such as inhabite in the North partes
the worlde, and Autumne and Winter to the inhabitants of the South
of the Worlde: this circle doth touch the Ecliptick in the first mi-
nute ♋, where the Sun beginneth his returne toward the South, where-
of tooke the name Tropick, which signifieth conuersion or returne, by
point of the Ecliptick, the diurnall motion describeth this Circle.

What is the tropick of Capricorne?

The Tropick of ♑, is one of the lesser circles deuiding the sphere into 2.
vnequall partes, and is described vpon the pole Antartick, a parallell to
Equinoctiall 23. degrées, 28. minutes from him, being the farthest ben-
of the Ecliptick towards the South, to which when the Sunne com-
the daies are then longest to al those that inhabite in the South parts
the worlde, and shortest to the Northern inhabitants: betwéene this cir-
and the Equator are included the 6. Southern signes, ♎, ♏, ♐, ♑, ♒, ♓,
which signes during the time that the Sunne abideth, being from the 13.
September to the 11. of March, he hath South declination, and then is
ing and the Summer to all such as inhabit the South partes of the
and Autumne and Winter to all the inhabitants in the North the
of the worlde: this circle toucheth the Ecliptick in the first minute
♑, which point the diurnall motion describeth this parallel.

What is the vse of the Tropicks?

By the Tropicks the Suns declination is known, as also the tropickes
by the Sunnes farthest motion towards the North and South, for so
much as the Tropicks are distant from the Equator, so much is the sunnes
greatest declination: and such as is the Suns greatest declining, such is the
space betwéene the Tropicks and the Equator: they are also the limits of
the burning zone, seperating the burning and temperat zones. For betwéen
the

the two Tropicks is contained the burning Zone.

What is the Artick polar Circle?

THe artick Polar Circle is one of the lesser circles, deuiding the [illegible] into two vnequall partes, and described vpon the Pole Arti[illegible] parallell, to the Tropick of ♋, hauing such distance from the Pole [illegible] Tropick hath from the Equator, being 23. degrées 28. minutes, vpon [illegible] circle the Artick pole of the Zodiac is placed, which being fixed in the [illegible] ment, by the vertue of the first mouer is carried about with the heau[illegible] which motion this circle is described.

What is the Antarctick polar circle?

THe Antartick polar circle is opposite to the Artick, and parallell [illegible] Tropick of ♑, being in all respect of such distance and description [illegible] and about the pole Antartick, as the Artick polar circle is about the [illegible] Artick.

What is the vse of the Artick and Antartick polar Circles?

THe vse of these 2. polar Circles, is to shew the distance of the pole[illegible] Zodiac, from the poles of the World, for so much as the [illegible] points are distant from the Equator, so much are the poles of the [illegible] from the poles of the World: these circles do also deuide and [illegible] temperate and frozen zones, for betwéene the Tropick of ♋ and the [illegible] Polar circle is contained the Northern temperate zone, and betwe[illegible] Artick polar circle and the pole artick, that is, within the Artich polar [illegible] is contained the Northern frozen zone. Also betwéen the Tropick of [illegible] the Antartick polar circle, is contained the Southern temperate [illegible] within the said polar circle is included the Antartick frozen zone, [illegible] are all the circles that are described vpon the body of the Globe.

What is the Meridian?

THe Meridian is a great circle passing by the Poles of the World [illegible] by your Zenith, deuiding the Horizon into 2. equall parts, in the [illegible] North and South, it also deuideth the sphere with all the parallell[illegible] therein contained, into 2. equall partes, crossing them at right spherick[illegible] gles. And this Meridian is not fixed in the firmament as the rest of the [illegible] cles are, for if it were, then should it be moued with the first mouer [illegible] rest are but it is not so: therfore the Meridian is manifested vpon the Gl[illegible] by a circle or ring of copper fastened vnto the Globe, vpon the 2. Poles [illegible] that the Globe moueth round vpon his 2. Poles within the Meridian: [illegible] Meridian is graduated in euery of his quarters into 90. degrées, by [illegible] his ble is perfourmed: and note that one Meridian may haue many [illegible] zons, yet euery Horizon hath but one Meridian, for if you trauaile South [illegible] North, you keepe still vpon the same Meridian, yet in euery sensible [illegible] rence of distance you shall enter into a change of Horizons, for there [illegible]

Horizons as there be sencible differences of distance, and there be as
Meridians as there be sencible differences of distance, so that the dif-
be not vpon the points North and South, but this copper Meridian
to the Globe is to be applyed to all differences and distances what-
as amply as if the number were infinite.

What is the vse of the Meridian?

vse of the Meridian is to know the highest ascending of the Sun,
me or Starres from the Horizon, for when they bee vpon the
then are they farthest from the Horizon, and then is the most con-
time to take the altitude of the Sunne or Starres, thereby to finde
les elevation.

the Meridian of your Globe is known the latitude and longitude of a-
vpon the Globe contained, for if you bring any place vnder the Me-
the degrees of the Meridian do shew the latitude of the same, and that
of the Equator which the Meridian doth crosse is the longitude, &c.

What is the Horizon?

Horizon is a great circle deuiding the heauens into 2. equall parts
one halfe being aboue the Horizon is alwaies in sight, the other
part being vnder the Horizon, and therefore is called the finitor
our sight, for where the heauens and seas seeme to ioyne toge-
is the Horizon: the Horizon is not seene in the firmament, and yet
circle constant to his proper latitude, but because in the Globe one
one Horizon may performe what euer is required to all elevati-
Horizon is so artificially annexed to the Globe, that by the motion of
, in the same there faulteth nothing in his vse: and the Hori-
all respects differenced as is the Sea Compasse. There are two
Horizons, a right Horizon, and an oblique Horizon: when the
are in the Horizon, then it is a right Horizon, for then the Equator
the Horizon in right angles, making a right Sphere and a right
, an oblique Horizon is where either of the Poles are elevated
same, for then the Equator doth cut the Horizon in vnlike angles,
an oblique Sphere, and an oblique Horizon, and although the Hori-
mers and many in number, for euery sencible difference of distance
newer Horizon, yet is the Horizon of the Globe so conuenient to
thereunto, as that by the mouing of the Meridian in the Horizon,
the Globes motion in the Meridian, both the Horizon and Meridian
applyed as proper to al places whatsoeuer: and note that the place
you are, is alwaies the center of the plaine superficiall Horizon.

What is the vse of the Horizon?

Horizon is the beginning of all altitude, for whatsoeuer is aboue the
zon, is said to haue altitude more or lesse, and by the Horizon such

altitudes are giuen with helpe of the croſſe ſtaffe, for placing the croſſe ſtaffe at your eye, if by the one end of the tranſuerſary you ſée the Horizon, and by the other end (at the ſame inſtant) you ſee the body obſerued, then doth the tranſuerſary ſhew vpon the ſtaffe the altitude deſired, by the horizon the nauigable courſes from place to place are likewiſe knowen, as alſo the quantitie of the riſing and ſetting of the Sunne, moone and Starres: whereby is knowne the lenght of the daies and nights in all climats and at all ſeaſons, by the Horizon is known vpon what degrée of Azumuth, the Sun, moone or Starres are, when they may be ſéene, in what part of the Heauen they are, whereby the variation of the Compaſſe is found, and the Poles altitude may at all ſeaſons be giuen.

Are theſe all the circles appertaining to the Globe?

THere are other Circles which are fired and doe properly appertaine to euery particular Horizon, as Azumuths, Almicanters, the Artick and Antartick circles.

What are circles of Azumuth?

CIrcles of Azumuths, or verticall circles, are quarters of great circles concurring together in the Zenith, as the meridians do in the pole, and are extended from the Zenith to euery degrée of the Horizon, etc. And becauſe they cannot be conueniently deſcribed vpon the Globe to be applyed to al Horizons, therefore vpon the Meridian of the Globe there is a peece of copper artificially placed, to be removed to any degrée of the Meridian at pleaſure, which peece of copper repreſenteth the Zenith, and muſt alwayes be placed ſo many degrées from the Equator, as the Pole is eleuated aboue the Horizon: and vnto this Zenith there is ioyned a quarter of a great circle called Quarta altitudo, the end whereof doth continually touch the Zenith, and is alſo ioyned to the Zenith, as that it may be mouued round vpon the Horizon, and to euery parte thereof at your pleaſure: this Quarta altitudo is diuided into 90. degrées, being the diſtinction of all altitude, and beginneth to accompt from the Horizon, which is the beginning of altitude, and endeth 90. degrées in the Zenith, being the end and extreme lyne of all altitude.

What are Almicanters?

ALmicanters or circles of altitude, are parallel circles to the horizon, and are deſcribed vpon the Zenith, as the parallels to the equator, are deſcribed vpon the Poles, of which circles there are 90. anſwerable to the diſtinctions of the Quarta altitudo, which are the degrées contained between the Horizon and Zenith, theſe circles cannot be deſcribed vpon the Globe, to be applyed to euery Horizon, but they are diſtinguiſhed by the circular motion of the Quarta altitudo, for if I deſire to know the Almicanter circle of 10. degrées, by moouing the Quarta altitudo round about the Horizon, the Zenith

gle of their quarter circle, doth shew the Almicanter desired, in what elevation soeuer.

What is the vse of these two circles?

The quarta altitudo performeth the vse of both, by the quarta altitudo and Horizon the courses from place to place are known according to the Horizontall position, as hereafter shall plainly appeare: it also sheweth the degree of Azimuth, and obserued altitude of any celestiall body, in what place soeuer: by the quarta altitudo and Horizon, you may describe a small Compasse vpon the Globe, the Poles height is at all times therein be knowne, and the variation of the Compasse is thereby likewise given as hereafter in the practise you shall be taught.

What are the Artick and Antartick circles?

Euery Horizon hath his proper Artick or Antartick circle, those Horizons that haue the Pole Artick elevated aboue them, haue their proper Artick circle, and those that haue the South pole elevated, haue their proper Antartick circle, the quantitie of which circle is according to the Poles elevation: for if the Pole be much elevated, then is the Artick circle great, for the Poles altitude is the semidiameter of this circle, if the pole be in the Zenith then halfe the Heauens is the Artick circle.

What is the vse of this circle?

The Sunne, Moone, or any Starres be within this circle, they are neuer carried vnder the Horizon during the time of their abode therin, whereby it commeth to passe that such as trauaile far towards the North haue Sunne in continuall viewe, and those that inhabite vnder the pole if any the Sunne is in continuall light for a time, moneths together, because the Septentrionall signes are within the Artick circle, the Equator in the Horizon &c.

There is another small circle, which is called Circulus horarius, or the hour circle, to be annexed to the Meridian of the Globe, for the perfection of vse, this circle must be deuided into 24. equall partes or houers, and the againe into such parts as you please for the better distinction of time: this circle must be fastened to the meridian, so that the houers 12. must stand iustly vpon the edge of the Meridian, and the Pole must bee the center of this circle, vpon which pole there must be fastened an Inder to moue proportionably, as the sphere (vpon any occasion) shalbe moued.

There is also an halfe circle, called the Circle of position, which sith it is not to no great purpose for Nauigation I here omit, and thus is the Globe fully finished for the perfection of this vse.

What are the Poles of the world?

There are two Poles the North or artick Pole, and the South or antartick Pole, which poles are two immoueable prickes fixed in the firma-

met, whereupon the sphere is moued by vertue of the first mouer, and are the limits of the Axis of the worlde, as also the extreme terme or band of declination, being 90. degrees from all partes of the Equator.

By the rayling of the Pole from the Horizon, is knowne the parallel or latitude of our being, it also giueth the quantitie of the Artick circle, and the obliquitie of the sphere.

What is the Axis of the world?

THe Axis of the worlde is a right line passing by the center of the sphere, and limited in the circumference, about the which the Sphere moues, and is therefore called the Axis of the Sphere, and as all lines commensurable are limited betweene two pointes or pricks, so is the Axis of the worlde, and those two limiting pricks are called the Poles of the world.

What are the Poles of the Zodiac?

THe zodiac hath likewise two Poles, Artick and Antartick, being two prickes fixed in the firmament, limiting the Axis of the zodiac, and are distant from the Poles of the worlde 23. degrees, 28. minutes, which Poles by the motion of the Sphere doe describe the Polar circles, performing their motion about the Poles of the worlde in euery 24. houres, by meane of the first mouer, vpon these poles the Ecliptick and zodiac is described: also a quarter of a great circle graduated into 90. degrees, being fastened together of these Poles and brought to the center of the Star, sheweth by the graduation the latitude of the same Starre, and where the quarter circle toucheth the Ecliptick, that is likewise his longitude, and the 7. Planets doe performe their naturall reuolutions vpon these Poles, whose motion is from the West towards the East, contrary to the motion of the first mouer.

What is the Axis of the Zodiac?

THe Axis of the zodiac, is a right line passing by the center of the sphere, and limited in the circumference, whose limiting poyntes are the Poles of the zodiac, and this Axis is mooued with the Sphere as are the Poles.

What are the Poles of the Horizon?

THere are two Poles of the Horizon, which are the limits of his perpendicular diameter, being equidistant 90. degrees from all parts of the Horizon, and are the extreme limits of all altitude, that Pole which is in the vpper Hemisphere is called the zenith, and his opposite Pole is called Nadir, they are extended in the firmament but not fixed in it, for they moue neuer, but remaine alwaies stable to their proper Horizon, which could not be if it were fixed in the firmament, for then should they be mooued with the firmament as the rest are, by the helpe of these Poles is found the Azimuth and Almicanter of any celestiall body, for a quarter circle deuided into 90. degrees, and fixed to the zenith as is the Quarta altitudo, being mooued to-

ward

celestiall body, doth by those degrées shewe the almicanter or altitude of same boope from the Horizon, and that parte of the Horizon which the ter circle teacheth, is the Azimuth of the same body, alwayes provided the zenith stand answerable to the Poles elevation, that is, so many de- from the Equator, as the Pole is from the Horizon.

How many Zones are there?

There are 5. zones, 2. temperate zones, 2. frozen zones, and one burning zone, the burning zone lyeth between the two Tropicks, whose la- is 46. degrées, 56. minutes, which zone by auncient Geographers is ed to be not habitable, by reason of the great heat which ther they sup- to be, through the perpendicularitie of the Sunne beames, whose per- all motion is within the said zone, but we finde in our trauels, contra- their repoze, that it is not onely habitable, but very populous, contai- many famous and mightie nations, and yéldeth in great plentie the rest thinges that by natures benefits the earth may prodreate: twice sayled through this zone, which I found in no sorte to bee offensiue,

mēt, whereupon the sphere is moued by vertue of the first mouer, and are the limits of the Axis of the worlde, as also the extreme terme or band of all declination, being 90. degrees from all partes of the Equator.

By the rayling of the Pole from the Horizon, is knowne the parallell or latitude of our being, it also giueth the quantitie of the Artick circle, and the obliquitie of the sphere.

What is the Axis of the world?

THe Axis of the worlde is a right line passing by the center of the sphear, and limited in the circumference, about the which the Sphere moueth, and is therefore called the Axis of the Sphere, and as all lines commensurable are limited betweene two poyntes or pricks, so is the Axis of the worlde, and those two limiting pricks are called the Poles of the world.

What are the Poles of the Zodiac?

THe zodiac hath likewise two Poles, Artick and Antartick, being two pricks fixed in the firmament, limiting the Axis of the zodiac, and are distant from the Poles of the world 23. degrees, 28. minutes, which Poles by the motion of the Sphere doe describe the Polar circles, performing their motion about the Poles of the worlde in euery 24. houres, by vertue of the first mouer, vpon these poles the Ecliptick and zodiac is described: also a quarter of a great circle graduated into 90. degrees, being fastened together of these Poles and brought to the center of the Star, sheweth by the graduation the latitude of the same Starre, and where the quarter cirkle toucheth the Ecliptick, that is like wise his longitude, also the 7. Planetes performe their naturall reuolutions vpon these Poles, whose motion is from the West towards the East, contrary to the motion of the first mouer.

What is the Axis of the Zodiac?

THe Axis of the zodiac, is a right line passing by the center of the sphere, and limited in the circumference, whose limiting poyntes are the Poles of the zodiac, and this Axis is moued with the Sphere as are his Poles.

What are the Poles of the Horizon?

THere are two Poles of the Horizon, which are the limits of his perpendicular diameter, being equidistant 90. degrees from all parts of the Horizon, and are the extreme limits of all altitude, that Pole which is in the vpper Hemisphere is called the zenith, and his opposite Pole is called Nadir, they are extended in the firmament but not fixed in it, for they moue not, but remaine alwaies stable to their proper Horizon, which could not be if it were fixed in the firmament, for then should they be moued with the firmament as the rest are, by the helpe of these Poles is found the Azimuth and Almicanter of any celestiall body, for a quarter circle deuided into 90. degrees, and fixed to the zenith as is the Quarta altitudo, being moueable

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celestiall body, doth by those degrées shewe the almicanter or altitude of the same bodye from the Horizon, and that parte of the Horizon which the meridian circle teacheth, is the Azimuth of the same body, alwayes provided the zenith stand answerable to the Poles elevation, that is, so many degrées from the Equator, as the Pole is from the Horizon.

How many Zones are there?

There are 5. zones, 2. temperate zones, 2. frozen zones, and one burning zone, the burning zone lyeth between the two Tropicks, whose latitude is 46. degrées, 56. minutes, which zone by auncient Geographers is supposed to be not habitable, by reason of the great heat which ther they suppose to be, through the perpendicularitie of the Sunne beames, whose perpetuall motion is within the said zone, but we finde in our travels, contrarie to their reporte, that it is not onely habitable, but very populous, containing many famous and mightie nations, and yeldeth in great plentie the greatest thinges that by natures benefits the earth may procreate: twice have I sayled through this zone, which I found in no sorte to bee offensiue, but

but rather comfortable vnto nature, the extremitie of whose heate is not
tions but tollerable, whose greatest force lasteth but 6. howers, that is
9. of the clocke in the morning, vnto 3. in the afternoone, the rest of the
and night is most pleasing and delightfull: therefore they did nature
in their rash reporte.

Of the frozen Zones.

THe frozen zones are contained within the polar circle, the Artick fro
zone within the Artick polar circle, and the antartick frozen zone wi
in the Antartick polar circle, which are also reported not to be habitable,
reason of the great extremitie of colde, supposed to be in those partes, becau
of the Sunnes farre distance from those Zones, but in these our dayes h
find by experience, that the auncient Geographers had not the due consi
ration of the nature of these zones, for three times I haue bene within
Artick frozen zone, where I haue found the aire very temperate, yea and ma
ny times in calme wether merueilous hot: I haue felt the Sunne be
of as forcible action within the frozen zone in calmes nere vnto the shor
I haue at any time found within the burning zone, this zone is also in
ted with people of good stature, shape, and tractable conditions, with
I haue conuersed and not found them rudly barbarous, as I haue found
Caniballs which are in the straights of Magilane, and Southerne part
America: In the frozen zone I discouered a coast which I named Desol
on at the first viewe thereof, supposing it by the loathsome shape to be
and desolate, but when I came to Anchor within the harbours thereof,
people presently came vnto me without feare, offering such poore things
they had to exchange for yron nailes and such like: but the Caniballs of Ame
rica flye the presence of men, shewing themselues in nothing to differ fro
brute beastes: thus by experience it is most manifest that those zones
haue bene esteemed desolate and waste, are habitable, inhabited and fr
full. If any man be perswaded to the contrary of this truth, he shall doe
selfe wrong in hauing so bas an imagination of the excellency of Gods
ation, as to thinke that God creating the world for mans vse, and the
being deuided but into 5. parts, 3. of those partes should bee to no p
but let this saying therefore of the Prophet Esayas be your full satisf
to confirme that which by experience I haue truely spoken: *For thus
the Lorde that created heauen, God himselfe that framed the earth and
it, hee that prepared it, hee created it not in vaine, hee framed it to be
bited, &c.* Esai 45.18.

Of the temperate Zones.

THe temperate Artick zone is included betweene the Tropick of
the Artick Polar circle, whose latitude or breadth is 42. degrees,

within the which we haue our habitation.

The temperate Antartick zone is limited by the tropick of ♑ and the Antartick Polar circle, and hath breadth or latitude 42. degrees, 2. minutes.

What is a Climate?

Climate is the space or difference vpon the vpper face of the earth, included betweene two parallells, wherein the day is sensibly lengthened one halfe an houer, for as you trauaile from the Equator toward the Pole, the Sunne hauing North declination, the daies doe grow longer longer, vntill at last the Sunne not setting vnder the Horizon, you haue continuall day, and euery space or distance that altereth the day an houer, is called a Climate: these Climates take their names from famous places as are within the saide Climates, of which there are 9. their distinctions may appeare.

The first passing through Meroe, beginneth in the latitude of 12. de. and endeth in 20.d.30.m. whose breadth is 7.d. 45.m.

The second passing through Syene, beginneth in the latitude of 20.de. and endeth in 27.d.30.m. whose breadth is 7.d.

The third passing through Alexandria, beginneth in the la. of 27.d.30.m

and

and endeth in 33.d.40.m. whose breadth is 6.d.10.m.

4. The fourth passing by Rhodes, beginneth in the la. of 33.d.40.m. and endeth in 39.d. whose breadth is 5.d.20.m.

5. The fifth passing by Rome, beginneth in the la. of 39.d. and endeth in 43.d.30.m. whose breadth is 3.d.45.m.

6. The first passing by Boristhines, beginneth in 43.d.30.m. and endeth in 47.d.15.m. whose breadth is 3.d.45.m.

7. The seventh passing by the Rhipaan mountaines, beginneth in 47.d.15.m. and endeth in 50.d.30.m. whose breadth is 3.d.15.m.

8. The eight passing by Meotis or London, beginneth in 50.d.30.m. and endeth in 52.d.10.m. whose breadth is 2.d.50.m.

9. The ninth passing by Denmarke, taketh his beginning in the latitude of 53.d.10.m. and endeth in the latitude of 55.d.30.m. and hath in breadth 2.d. 20.m.

If you desire to know how many leagues every Climate is in breadth, allow for every degree 20. leagues, or 60. miles, and for every minute one mile, so is the distance given.

Thus have I manifested unto you all the divisions and particulars of the Spheres distribution.

What is the vse of the Globe?

The vse of the Globe is of so great ease, certainty, and pleasure, as that the commendations thereof cannot sufficiently be expressed, for all instruments it is the most rare and excellent, whose conclusions are [illegible], giving the true line, angle, and circular motion of any Corse or [illegible] that may in Navigation happen, whereby the longitude and latitude is most precisely knowne, and the certainty of distance very plainelye [illegible], according to the true nature thereof: it giueth the variation of the Compasse, and the hower or time of the day at all seasons, and in all places, and by the Globe the Poles height may at all instants and vpon euery [illegible] or azimuth of the Horizon by the Sunnes altitude taken be most precisely knowne, by the certainty of whose excellent vse, the skilfull Pilot shall [illegible] great content in his pleasing practise gubernautick.

How are distances measured vpon the Globe?

When there are 2. places assigned the distance, betweene which you desire to know, with a paire of circular compasses you must doe it [illegible] sort: set one foote of the compasses vpon one of the places, and the [illegible] foote vpon the other place, the Compasses so stretched forth, bring vnto the Equator, and as many degrees as may be contained betweene those [illegible] points of the Compasse, allowing 20. leages for euery degree is the [illegible] desired or if the places be of such distance as that you cannot with [illegible] Compasses reach them, then take with the Compasses 5. degrees of [illegible] Equator, which is 100. leages, or 10. degrees for 200 leages, and so [illegible] how often the distance is contained betweene the said places, if any [illegible] of a degree doth remaine, for halfe a degree allow 10. leages, for a [illegible] 5. leages, &c. but if you desire a most exquisite precisenes in measuring to the minute, second and third, then do thus. When your Compasses [illegible] fall vpon any part of a degree, note the distance between the end of that [illegible] and the point of the Compasses, then with a paire of conuenient compasses take the distance, then measure the same 60. times vpon the equator, [illegible] of some certaine place) then consider how many degrees are contained within the measure, and allow euery degree to be a minute or mile, so [illegible] leages and miles knowne, if any parte of a degree remaine vpon [illegible] of minuts, do so at the first, measuring the same 60. times vpon [illegible], the degrees comprehended within the mesure, are seconds: if any [illegible] of a degree remaine vpon these seconds, do as in the first, and the degrees contained in this measure are thirds, and so you may proceed infinitly.

How may the Globe be rectified answerable to the true position of the heauens, for any place, city, or promontory?

The place being knowne for which you woulde rectifie the Globe, doe [illegible] bring the place vnder the Meridian, and there consider the latitude

tude thereof: and as many degrees as that place is from the Equator, [illegible] many degrees you must eleuate the Pole from the Horizon, then bring [illegible] Zenith directly ouer the same place, and so is your Globe rectified for the [illegible]ecution of any practise: and without this ordering of the Globe, there is [illegible] conclusion to be executed by the same.

How is the longitude and latitude of places known by the Globe?

BY turning the Globe within the Meridian, you must bring the [illegible]montory, Bay, Harborow, Cittie, or other place, (whose latitude [illegible] longitude you seeke) precisely under the Meridian, there holding the [illegible] stedy, the degree of the Meridian that is directly ouer the said place, [illegible] the latitude thereof, and that degree of the Equinoctiall which is directly [illegible]der the Meridian, is the longitude of the same place.

How is the Corse found between place and place?

TWo places being assigned, the Corse betweene which you [illegible] know, first seek the latitude of one of these places, and rectify the [illegible] answerable unto the same, as before is taught, then bring that place [illegible] under the Meridian and zenith, if both places be under your meridian [illegible] then lye North and South, if not, then bring the Quarta altitudo [illegible] ther place, and note upon what parte of the Horizon the end of the [illegible]cheth for that is the precise Horizontall Corse between the said places [illegible] this you must consider, that the Horizontal Corse is not the nauigable [illegible] unles the places be of final distance, for if any place bare Northeast [illegible] or East from me, or upon any other point, North or South excepted [illegible] distant 500. leages, if I saile upon the Horizontall Corse, I shall [illegible] riue unto the same place.

How then shall the Pilote saile by the Globe, if the matter be so doubtfull?

THe skilfull Pilote that useth this excellent instrument, doth first [illegible]der the place from whence he shapeth his corse, and rectifieth the [illegible] answerable to the same, then bringing the place directly under the [illegible] and Zenith, there holding the Globe stedy, bringeth the Quarta altitudo [illegible] the place for which he is bound, the end wherof sheweth upon the [illegible] the true Horizontall Corse, upon which Corse he saileth 20. or 30. leages [illegible] there maketh a note or prick by the edge of his Quarta altitudo, [illegible] to the true distance proued by Corse, reckoning an altitude as in the [illegible] Chart: then he bringeth that prick or note under the Meridian, [illegible] considereth the true latitude of his being, he then rectifieth the Globe [illegible]rable to the same prick, and keeping the same under the Zenith, doth [illegible] turne the quarta altitudo to the place for which he is bound, the end [illegible] sheweth upon the Horizon the Horizontall Corse, then sayling [illegible]

maketh a note or prick as before. and thus prosecuting his Corse, shall a-
unto his desired place: but in this practise he shall plainely proue that his
ontall Corse will differ greatly, and that by his sayling in this sorte,
all by his notes and pricks describe the true nauigable and neerest Cor-
betweene the saio places: The like methode is to be obserued vpon any
ers or forced course whatsoeuer: and therefore the Pylote must take
that although the winde be neuer so fauourable, yet he must not prose-
any Horizontall Corse (North and South only excepted.)

Therefore I say the Pylote must take speciall care to consider the di-
of places, whether the Horizontall Corse will lead him betweene the
places: for if places be more then 45. degrees asunder, the Horizontall
is not the meane to find those places, vnlesse they lie north and south:
Horizontall course betweene any 2. places, is a portion of a great cir-
which being of large distance, must be perfourmed by great circle naui-
and not by Horizontall Corses: for the collection of many Horizon-
Corses being knit together, doe performe a paradoxall motion, altoge-
differing from a great circle, as for an example: being at Cape verde,
a place distant from me 80. degrees, vpon the point Northwest, vnto
place I desire to saile, I therfore bring Cape verde vnder the Meri-
my Globe, there considering the latitude of the Cape, I rayse the
answerable to the same, and place the Zenith directly ouer the Cape,
ning the quarta altitudo to the point Northwest vpon the Horizon,
places as the sayde quarta altitudo then toucheth, doe beare due
west from me: now prosecuting this Corse by the direction of my
se, the first day I saile 20. leages, therefore I make a marke by the
the quarta altitudo, 20. leages from the Zenith, then bringing that
under the Meridian, I rectifie the Globe answerable to the latitude
the next day I sayle other 20. leages vpon the same point, and make
as at the first, I bring that marke likewise vnder the Meridian,
the Globe as before, and by this methode prosecuting the Corse
I shall describe a paradoxall line, which will leade me to the North
place vnto which I would sayle, the farther the distance, the greater
rence: by this order you may describe paradoxall lines, vpon all the
of the Campasse, but this is to be regarded, that your differences be as
as you may, and that none of them exceed 20 leages, for by the smallest
tions, is perfourmed the greatest certaintie. And by the description of
lines, you may very manifestly vnderstand the differences of Horizon-
paradoxall and great circle Nauigation.

This may suffice for the sayling vse of the Globe, conuenient for the
purpose.

What is great Circle nauigation?

GReat Circle nauigation is the chiefest of all the 3. kindes of sayling, in whom all the other are contained, and by them this kinde of sayling is performed continuing a Course by the shortest distance betweene places, not limited to any one Course, either horizontall or paradorall, but by it those Courses are ordered to the full perfection of this rare practise, whose benefites in long voyages are to great purpose, ordering and disposing all horizontall trauerses to a perfecte conclusion: for there are many changes of horizontall and paradorall Courses in the execution of this practise, so that vpon the setting of a winde, when that it may seeme that you are forced to an inconuenient Course by the skill of great Circle sayling, that Course shall be found the shortest and onely proper motion to performe your voyage. And also when with fauourable windes the Pylote shall shape a Course by his Chart and Compasse paradorall, as the best meane to attaine his porte, he shall by this kinde of sayling finde a better and shorter Course, and by sufficient demonstration proue the same, so that without this knowledge I see not how Courses may be ordered to their best aduantage: therefore sith by it the perfection of sayling is largely vnderstode, and the errors likewise most substantially controled, it may of right chalenge the chiefest place among the practises Gubernautick. The particularities whereof if I should by an ordinary methode labour to expresse, it would be a discourse ouer large for this place, and as I thinke troublesome if the premisses be not well vnderstode: therefore I will now ouerpasse it, vntill a time more conuenient and of better leasure.

Of paradoxall nauigation.

PAradorall Nauigation, demonstrateth the true motion of the Ship vpon any Course assigned, in his true nature by longitude, latitude and distance, giuing the full limit or determination of the same, by which motion lines are described neyther circular nor straight, but concurred of winding lines, and are therefore called paradorall, because it is beyond opinion that such lines should be described by plaine horizontall motion: for the full perfection of which practise I purpose (if God permit) to publish a paradoxall Chart with all conuenient speede, and so will discouer by the same at large all the practises of paradorall and great circle nauigation, for vpon the paradoxal Chart, it will best serue the Seamans purpose, being an instrument portable, of easie stowage and small practise, performing the practises of Nauigation as largely and as beneficially as the Globe in all respects: and all these practises of sayling before mentioned, may in a generall name aptly called Nauigation Geometricall, because it wholy consisteth of Geometricall demonstratiue conclussions.

But there is another knowledge of Nauigation, which so farre excelleth that is before spoken, or that hath hitherto beene vulgarly practised, as substance his shadow, or as the light surpasseth the thick obscured darke: and this sweete skill of sayling may well be called Nauigation arithmeticall, because it wholy consisteth of Calculations, comprehended within limit of numbers, distinguishing Corses not only vpon the points of the Compasse, but vpon euery degree of the Horizon, and giueth the distance of leuers for the particular elenation of minutes, yea, and lesse partes as your selfe: it giueth longitudes and latitudes to the minute second and in so great certaintie, as that by no other meanes the like can be performed: it teacheth the nature of Angles and Triangles, aswell Spherical as playne superficiall and solide Commensurations, the effect of lynes right, circular, and paradorall, the quantities and proportions of paralthe nature of Horizons, with euery particular distinction of any alteration whatsoeuer, that may in Nauigation be required, to a most wonderfull certaintie: for there can nothing be required, that by this heauenly Science of numbers shall not be most copiously manifested to the great admiration and great content: the orderly practise whereof to the simple capacitie I purpose to make knowne, if I may perceiue my paines already taken, to be receiued in good parte, which I distrust not but well minded Seamen, and Pylots of reputation will gratefully embrace, namely in regarde of my friendly good will towards them, for it is not great of my paines, but of my loue, that I would receiue fauorable cur-

How may the Poles height be knowne by the Globe?

There are diuers waies to finde the Poles height by the Globe, aswell from the Meridian as vpon the same, but sith before I haue sufficiently shewed by the Sunnes Meridian altitude, the Poles height may be had, I will therefore in this place speake no further thereof, but for the ornaments it may be knowne as followeth.

How by the Sunnes rising or setting, the Poles height may be knowne.

Your Compasse of variation, or some magneticall instrument, obserue the Sunne rising, vpon what degree of the horizon the center toucheth, according to the true horizontall position of the Magnet, all variation duly considered, that being knowne, search in the tables of the Ephimerides, for the Sunnes place in the Ecliptick, at the time of your obseruation, then marke that place or degree of the Ecliptick wherein you finde the Sunne to be, the Horizon, and moone the Meridian of the Globe accordingly, vntill that obserued degree of the Horizon and the Sunnes place in the Ecliptick doe iustly touch together, for then is the Pole in his due Elena-

tion, as by the intersection of the Horizon and Meridian may appear, in the first you may finde the Poles eltitude, by any knowne fixed Starre in the Horizon.

To finde the poles height by the Sunne, vpon any point of the Compasse.

BY the Compasse of variation, rectified to the true horizontall position, obserue the Sunne vntill he come to any point thereof at your pleasure, and at the same instant take the Suns height from the Horizon, then bring the quarta altitudo to that point of the Compasse vpon the Horizon of the Globe where you obserued the Sunne to be, there holding the quarta altitudo stedie, moue the Globe vntill you bring the degree of the Ecliptick (wherein the Sunne is at the time of your obseruation) vnto the edge of the quarta altitudo, if it fall vpon that degree of altitude as was the Sunnes obserued height, then doth the Pole stand to his true Elevation, but if it agree not, you must elevate or depresse the Pole as occasion requireth, applying the Zenith answerable thereunto. And againe make triall as at the first, bringing the place of the Sunne to the quarta altitudo, and setting the same vpon the obserued point of the Compasse, vntill it agree in all points with your obseruation, and then the Meridian sheweth in his intersection with the Horizon, the elevation of the Pole from the Horizon.

To find the Poles height by any given Azumuth by the Sun being aboue the Horizon.

BY your magneticall instrument, or compasse of variation obserue the Azumuth of the Sun at any time in the forenoone, or afternoone, the nearer the Sun is to the Horizon, the better shalbe your obseruation, and at the same instant take the height of the sun from the Horizon, keep these numbers in memory, and note that the Azumuth be obserued according to the position of the Horizon, by hauing good regard to the variation of y compasse, then bring the quarta altitudo to the place of the Sun in the Ecliptick, and set that degree of the Sunnes place in the Ecliptick vpon the obserued degree of altitude by the graduation of the quarta altitudo, and if the Azumuth thereof at the same instant doe fall right vpon the obserued degree of Azumuth, then is the Pole in his due Elevation: if not, then raise or lay the Pole as occasion requireth, alwaies regarding that you place the Zenith conuerable to the Poles altitude, and then againe bring the Sunnes place to his altitude vpon the Quarta altitudo, and loke againe whether the Azumuth thereof doe touch the obserued degree of Azumuth vpon the Horizon, if not you must prosecute this order, vntill at one instant the place of the Sun may be vpon his true almicanter, by the edge of the quarta altitudo, and the other end of the quarta altitudo doe also touch the obserued degree of Azumuth.

the Horizon, for then is the Pole in his true elevation, as by the Vertu and Horizon will appeare.

To find the Poles height by the Sunne by any two given Azumuths and altitudes, not regarding the true horizontall position or needles variation.

Because there may great errors be committed in the former observations vnlesse the Compasse be perfectly well rectified, to as it may respect the points or distinctions of the Horizon, it is not amisse to enforme you without regard of variation, the Poles height may be found. Therefore by your Magneticall instrument or Compasse of variation observe the Sunnes azumuth, without regarde of the true horizontall position: at the same instant observe also his altitude from the Horizon, keepe both numbers in memory, then after the Sunne hath moued a point or points of the compasse more or lesse at your discretion, observe again his azumuth and altitude as at the first, then consider the arke of the Horizon through which the Sunne hath moued betweene those two observations, for the two observations of the Sunnes altitude, and by the degrees of Azumuth through which the Sunne hath moued, the Poles height is thus found: First set the Globe to the elevation of the place wherein you are as neere as you can ghesse, and bring the Zenith to the like latitude from the Equinoctiall, as the Poles elevation is from the Horizon, then bring the quarta altitudo to the place of the Sunne vpon the Ecliptick, for the time of your observation, there place the Sunne vpon the first observed altitude by the degrees of the quarta altitudo, and note the degree of the Horizon which the quarta altitudo then toucheth: this done, bring the Sunnes place to the second observed altitude, by moving the quarta altitudo and the Globe vntill the degree of the Sunnes place in the Ecliptick and the degree of his altitude vpon the quarta altitudo doe meete. Then againe consider the degree of the Horizon which the end of the quarta altitudo toucheth, and note the parte of the Horizon contained betweene your two observations, of both degrees if it consisteth, if it agree with the observations made by your Magneticall instrument, then doth the Pole stand in his true altitude, if not either raise or depresse the Pole, and againe prosecute the former worke vntill you find such azumuths and altitudes vpon the Globe, as you haue by your Magneticall observations, for then the Pole doth stand in his true altitude, and then doth also appeare the true Azumuth of both your observations, which if it agree not with your compasse, then is your compasse faulty, and may hereby be corrected, so that this doth not onely giue the Poles height, but also the true horizontall position without errour.

To

To find the Poles height by taking the Suns altitude aboue the Horizon, so that the precise time of any such obseruation be knowne.

IF you desire at any time of the day to know the Poles height, as at 9. or 10. of the clocke, &c. marke diligently the time of your obseruation, & what instant you doe obserue the Sunnes altitude from the Horizon, the time and altitude thus knowne, bring that place of the Ecliptick where the Sunne is at the time of your obseruation directly vnder the Meridian, & holding the Globe stedye, bring the Inder of the circulus horarius to the howes of 12. or noone, then moue the Globe vntill the Inder come to the howre of your obseruation, there hold the Globe stedy, then bring the quarta altitudo to the place of the Sunne in the Ecliptick, if it agree with your obserued altitude, then doth the Pole stand in his true elenation, if not, rectify the meridian by raising or depressing the pole as occasion requireth, vntill by bring the altitude and the howre to agree, & then you haue the Poles height, and by the end of the quarta altitudo doth also appear the degree of azimuth whereupon the Sunne was at the time of your obseruation, and note that in raysing or depressing the Pole of the Globe, you must also place the Zenith as farre from the Equinoctiall, as the Pole is from the Horizon, for this is a generall rule, that so much as the pole is elenated from the Horizon, so much is the latitude of the Zenith from the Equator, therefore you must alwayes bring the Zenith and altitude to agree, whensoeuer you alter the Elenation, be it neuer so little.

To find the Poles height by any two obseruations of the Suns altitude, not regarding the howre of the day, or any Horizontall position of the Magnet, so that you know the distance of time betweene the said obseruations.

ALthough there be some difficultie in giuing the true time of any obseruations at the Sea, by reason of the alteration of Horizons, and the Magnetical needles variation, yet it is a matter most easie by a good howre glasse, a good halfe howre Glasse, and minute Glasse, to measure the distance of time betweene any two obserued altitudes, you may therefore vpon the Globe find the Poles height with great facilitie at any time, by the Sunne or any fixed Starre, in this sorte.

Consider in what place of the Ecliptick the Sunne is at the time of your first obseruation, bring that place to the Meridian, there with a blacke line or mooning the Globe describe a parallell to the Equator, answerable to the Sunnes diurnall motion and declination for the same instant, then betweene your obseruations there be an howre, two howres, more or lesse at your pleasure, as by your running glasses may be knowne, you must for euery howre 15. d. of the Equator, for so much ascendeth euery howre

and for euery 4. minutes one degrée, and for euery minute of a degrée, then knowing by this order how many degrées the Sunne is moued betweene your 2. obseruations, you must vpon the parallell which you drawe make 2. markes, so many degrées asunder as the Sunne hath moued betweene your obseruations, which may be done in this sorte: bring the place wherein the Sunne is vnder the Meridian, and mark what degrée of the Equator is then vnder the Meridian, the Globe so standing vpon your parallell close by the Meridian, make the first note or marke, then turne the Globe, and reckon by degrées of the Equator that passe vnder the Meridian, vntill so many be past as was your obseruation, there againe holde the Globe stedy and vpon your parallell close by the Meridian, make your second note or marke, then knowing the Sunnes altitude at both the obseruations, you must bring the Quarta altitudo to the first note made vpon your parallel, there holding the globe by the Quarta altitudo and mark agreeing in altitude, bring the Quarta altitudo to the second note, if that do also agrée with your former obserued altitude, then doth the Globe stand in his true Elevation, if not you must elevate or depresse the Pole by discretion, vntill you bring the 2. obserued altitudes of the Sunne to agrée with the two markes which you made vpon your described parallell, and then is the Pole at his true elevation, and what is required of the Sunne, the like may be done by any knowne starre. I holde this conclusion to be very necessary, pleasant, and easie for Seamans purpose.

To finde the true place of the Sun in the Ecliptick at all times.

Because it is most necessarily required in the former practises, that the Sunnes true place in the Ecliptick be at all times knowne, I thinke it meete to enlarge vnto you how the same may be done.

The chiefest and most certaine meane to know the same, is by the tables of Ephimerides, but those tables wanting, the Seaman may in this sorte by the Regiment seeke out the declination of the Sunne, that being found, bring the Zenith vpon the Meridian, so many degrées and minutes from the Equator as is the Sunnes declination, then moue the Globe vntill some degrée of the Ecliptick do come directly vnder the point of the Zenith, for that is the Sunnes place: you must further consider, whether it be betweene March and June, for then you must finde the degrée in that quarter of the Ecliptick, contained betweene ♈ and ♋: if it be betweene June and September, you must find the degrée in that quarter of the ecliptick contained betweene ♋ and ♎, &c. of the rest.

It may also be knowne vpon the Horizon of the Globe by a Calender that is there described, in this sorte: first search the day of your moneth wherein you desire to know the Sunnes declination, and directly against

gainſt the ſame degrée which ſtandeth for that day, doth alſo ſtand the degree of the Zodiac wherein the Sun is at the ſame time, in a circle repreſenting the Zodiac, and deſcribed vpon the Horizon.

But if it be Leap yeere, you muſt not take the preciſe day of the moneth wherein you ſeeke the Suns place, but the nert day following, and againſt that day ſeeke the declination.

To finde the Poles height by any two known fixed ſtars.

WHen you ſee any 2 fixed Starres which you know to be both at one inſtant in the Horizon, vpon your Globe ſearche for the Starres, and bring one of them to touch the Horizon of the Globe, if the other doe not likewiſe touch the Horizon, you muſt raiſe or depreſſe the Pole by diſcrete mouing of the Meridian, vntill you bring both thoſe Starres to be at one inſtant in the Horizon, for then the Globe doth ſtand to his true eleuation.

To finde the Poles height by any two known fixed Starrs another way.

WHen you ſee any fixed Starre that you know to be in the Horizon, you muſt preſently take the height of ſome other Starre, which you likewiſe know, before the firſt be riſen from the horizon, then vpon the Globe ſearch for the Starre that you obſerued in the horizon, bring him to the horizon of the globe, there holding the globe ſtedy, bring the quarta altitudo to the other Starre whoſe altitude you obſerued, if it agree with the Quarta altitudo with the obſerued altitude, then the Globe doth ſtand in his true eleuation, if not, you muſt by diſcretion raiſe or lay the Pole vntill you finde the one Starre in the Horizon, and the other vpon his true obſerued altitude, for then the Pole doth ſtand to his true eleuation.

To finde the Poles height at any time by any 2. knowne fixed Starres.

WIth your croſſe ſtaffe take the diſtance of any two ſtars from the Zenith, which muſt be done with as much expedition as may be, their diſtances ſo knowen, with a pair of compaſſes, meaſure ſo many degrees vpon the Equator, as is the diſtance of the firſt obſerued Starre, with another paire of compaſſes doe the like for the ſecond obſerued Starre, the firſt Starre ſet one point of the compaſſes that tooke his diſtance, and the ſecond Starre ſet likewiſe one foote of the compaſſes that tooke his diſtance, bring the other 2. feet of the compaſſes to meet together, there make a mark, for that is the parallel wherin you be, and that mark is the Zenith, bring it to the Meridian by mouing the Globe, and there will appeare the latitude deſired, for ſo many degrees and minutes as that marke is from the Equator, ſo much is the Pole eleuated aboue the Horizon. This rule the Seaman ought to haue in good eſteeme.

To know the precise hower at all times, by the Sunne.

Or the finding of the hower of the day by the Globe, it is necessary that the Poles height be first knowne, therefore set the Pole to his true elevation, and the Zenith to his answerable latitude, then bring the place of the Sunne in the Ecliptick vnder the Meridian, there holding the Globe stedy, set the Inder of the Circulus horarius vpon 12. of the clock or noone, your Globe thus ordered, then with your Crosse staffe take the Sunnes height from the Horizon, that being knowne, you must bring the place of the Sun to the Quarta altitudo, by mouing the Globe and quarta altitudo vntill the place of the Sunne doe agree with the obserued altitude, there holding the Globe that he moue not, the Inder doth shew vpon the circulus horarius, the hower desired.

To find the hower of the night by any knowne fixed Starre.

Set the Globe to his true altitude, and the Zenith to his answerable latitude, you must also place the Inder of the circulus horarius vpon the hower of 12. or noone, by bringing the Sunnes place vnder the Meridian, &c. as you did by the Sunne, then take the height of any knowne fixed Starre, bring that Starre to the quarta altitudo, by mouing the Globe and quarta altitudo vntill the Starre come to his true obserued altitude, there holding the Globe stedie, the Inder doth shewe vpon the circulus horarius the time of your obseruation.

To know the length of the daies and nights, at all times, and in all places.

The place and time being giuen wherin you desire to know the length of the day or night, first set the Globe to his true altitude for the place, then the place of the Sunne in the Ecliptick, for the time wherein you seeke the daies length, bring that place of the Sunne vnder the Meridian, holding the Globe that he moue not, place the inder of the circulus horarius vpon the hower of 12. or noone, then turne the Globe vntill you bring the place of the Sun to touch the East part of the horizon, there holding the Globe, you shall see by the Inder of the circulus horarius, the true time of the Sunnes rising, then bring the place of the Sunne to the West parte of the horizon, and you shall there see the true time of the Sunnes setting, whereby the length of the day and night doth most plainely appeare. And this may serue for the vse of the Globe, necessary for the Seamans purpose.

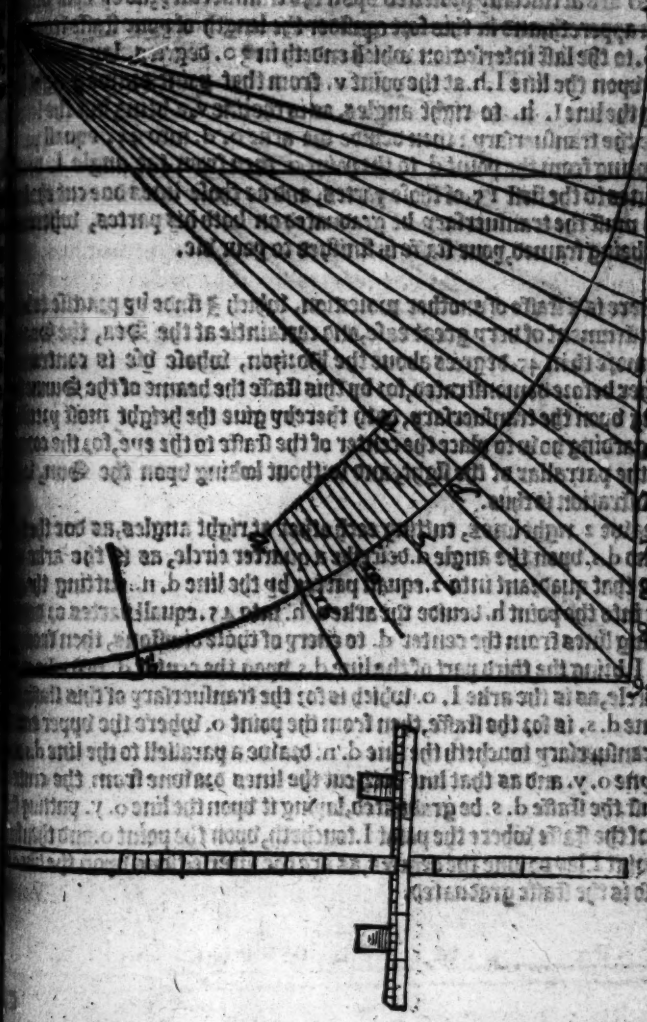
I might here recite the triple rising and setting of the Starres, Cosmice, Acronice, and Heliace, the ascentions right and oblique, the dawning and twilight, howers equall and vnequall ordenary and planetary, daies naturall and artificiall, the triple rising of the Sunne Equinoctiall and Solsticiall, Circles of position with their vse and nature, the horoscope and domifications of the heauens, the planets, their motions, retrogradiations, excentricitie of their orbs, horologie, and many other most pleasant conclusions:

clusions: but because they doe in no sort appertaine to the Seamans ... therefore omit them, as matters more troublesome then profitable ... expecting from some learned Mathematician a worke of worthy ... wherin these and many other excellent conclusions shall by cunning ... stration be made knowne vnto vs.

Of the Crosse staffe and his demonstration.

The Crosse staffe is an artificiall quadrant, geometrically ... that forme as an instrument of greatest ease and exactest vse in ... gation, by which in any naturall disturbance of wether (the Sunne ... appearing) the Poles height may be knowne, when the Astrolabe ... drant are not to be vsed. Conueying the vse of the quadrant from the ... of the Sunne to the beame of the eye, for whereas by the quadrant ... beame perceiuing the Dioptra sheweth his height, so by the crosse ... beame of the eye conueyed to the Sunne or Starre, doth likewise ... height. The demonstration whereof is thus.

Make a playne square consisting of 4. right angles, as is the ... I. o. h. n. the angle I. shalbe assigned the Center of the quadrant, ... placing one foote of your Compasses, stretch the other foote to the ... and therewith describe a quarter of a circle, as is the arke o. d. n. ... the center I. to his opposite angle h. draw a right line, by which ... quadrant o. d. n. is deuided into 2. equall partes, in the point d. ... arke d. n. into 90. equall partes, drawing from the center I. lines ... nery of those diuisions touching in the line o. h. as by this figure appeareth: ... then consider the length of your transuersary, and take halfe therof ... vpon the line I. o. in the point S. from that point S. draw a parallell ... lyne I. n. as is the lyne S. Y. and as that line doth interfect the diuisions ... the halfe quadrant, so shalbe the degrees of the crosse staffe, and note that ... sides of the square, must be as long as the staffe that is graduated.



because the staffe should be of vnreasonable length to contain more then degrees, therefore to keepe him in due forme for the ease of his vse, and the complement of 90. degrees should be contained vpon the staffe, the

other

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Make a playne square consisting of 4. right angles, as is the [illegible] I. o. h. n. the angle I. shalbe assigned the Center of the quadrant, [illegible] placing one foote of your Compasses, stretch the other foote to the [illegible] and therewith describe a quarter of a circle, as is the arke o. d. n. [illegible] the center I. to his opposite angle h. drawe a right line, by which [illegible] quadrant o. d. n. is deuided into 2. equall partes, in the point d. [illegible] arke d. n. into 90. equall partes, drawing from the center I. lines [illegible] uery of those diuisions touching in the line n. h. as by this figure [illegible] then consider the length of your transuersary, and take halfe therof [illegible] vpon the line I. o. in the point S. from that point S. drawe a parallell [illegible] lyne I. n. as is the lyne S. Y. and as that line doth intersect the [illegible] the halfe quadrant, so shalbe the degrees of the crosse staffe, and note that [illegible] sides of the square, must be as long as the staffe that is graduated.

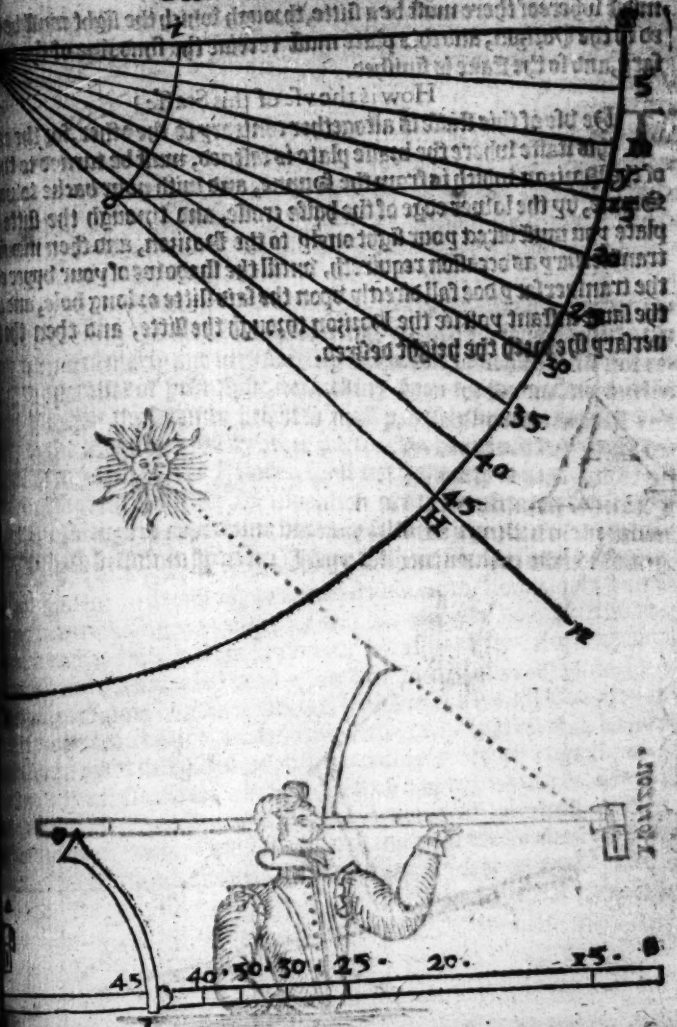
[illegible]ause the staffe should be of vnreasonable length to contain more then [illegible]egrees, therefore to keepe him in due forme for the ease of his vse, and [illegible] complement of 90. degrees should be contained vpon the staffe, the

 other

other 30. are artificially protected vpon the transuersary, as by this demonstration appereth, and in this sort consider the length of your staffe from the point S. to the last intersection which endeth in 30. degrees, lay downe the length vpon the line I.h. at the point v. from that point draw a right line cutting the line I. h. to right angles, as is the line v. 2. being iust the length of halfe the transuersary: then deuide the arke o. d. into 45. equall parts accompting from the point d. to the point o. then from the angle I. draw right lines to the first 15. of those partes, and as those lines doe cut the line v. 2. so must the transuersary be graduated on both his partes, wherein the vanes being framed, your staffe is finished to your vse.

There is a staffe of another protection, which I finde by practise to be a instrument of very great ease, and certaintie at the Sea, the sun not being more then 45. degrees aboue the Horizon, whose vse is contrarie to the other before demonstrated, for by this staffe the beame of the Sunne is followed vpon the transuersary, both thereby giue the height most precisely not regarding how to place the center of the staffe to the eye, for the correction of the parrallax of the sight, and without looking vpon the Sun, whose demonstration is thus.

Draw 2. right lines, cutting each other at right angles, as doe the lines d.v. and d.s. vpon the angle d. describe a quarter circle, as is the arke v. 2. deuide that quadrant into 2. equall partes by the line d. n. cutting the quadrant into the point h. deuide the arke v. h. into 45. equall partes or degrees, drawing lines from the center d. to euery of those diuisions, then from the point I. bring the third part of the line d.s. vpon the center d. describe part of a circle, as is the arke I. o. which is for the transuersary of this staffe, and the line d. s. is for the staffe, then from the point o. where the vpper end of the transuersary toucheth the line d. n. draw a parallell to the line d.s. as is the lyne o. y. and as that line doth cut the lines drawne from the center so must the staffe d. s. be graduated, laying it vpon the line o. y. putting that part of the staffe where the point I. toucheth, vpon the point o. and then from the point I. lay downe the degrees, as are the intersections vpon the line o. y. and so is the staffe graduated.

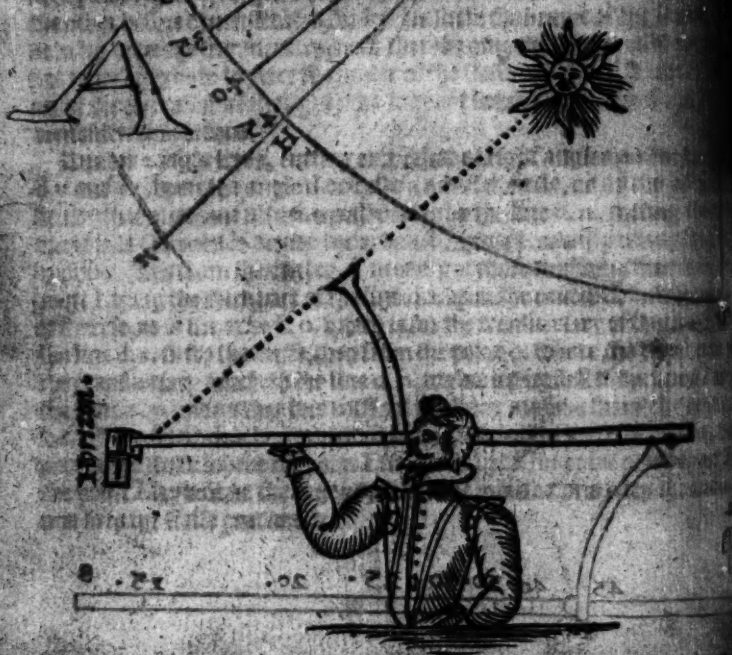


The transuersary at the point i. must haue an artificial hole made for the staffe to runne in, as other staues haue, also there must bée a plate of [illegible] with a soccat to be set to the center of the staffe, as is the figure [illegible]

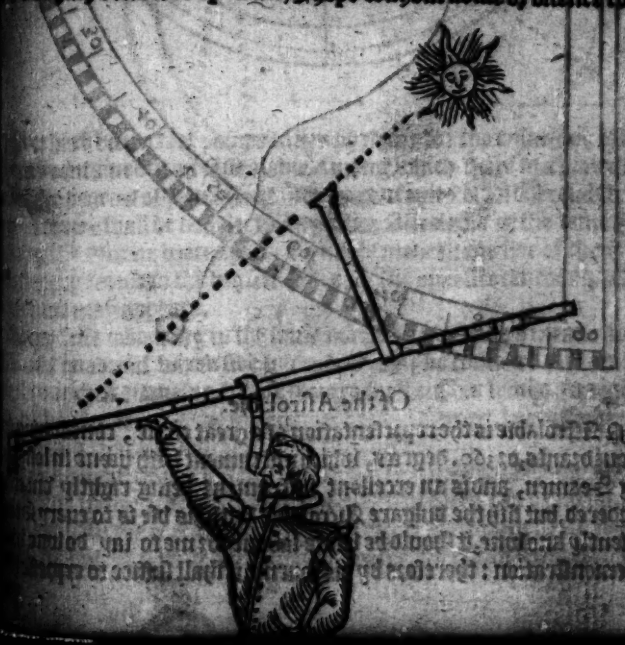
must whereof there must be a slitte, through which the sight must [illegible] ed to the Horizon, and this plate must receiue the shadowe of the [illegible] sary, and so the staffe is finished.

How is the vse of this Staffe?

The vse of this staffe is altogether contrary to the other, for the [illegible] this staffe where the brasse plate is fastned, must be turned to [illegible] of the Horizon which is from the Sunne, and with your backe [illegible] Sunne, by the lower edge of the halfe crosse, and through the [illegible] plate you must direct your sight onely to the Horizon, and then [illegible] transuersary as occasion requireth, vntill the shadowe of your [illegible] the transuersary doe fall directly vpon the said slitte or long hole, [illegible] the same instant you see the Horizon through the slitte, and then [illegible] uersary she wieth the height desired.

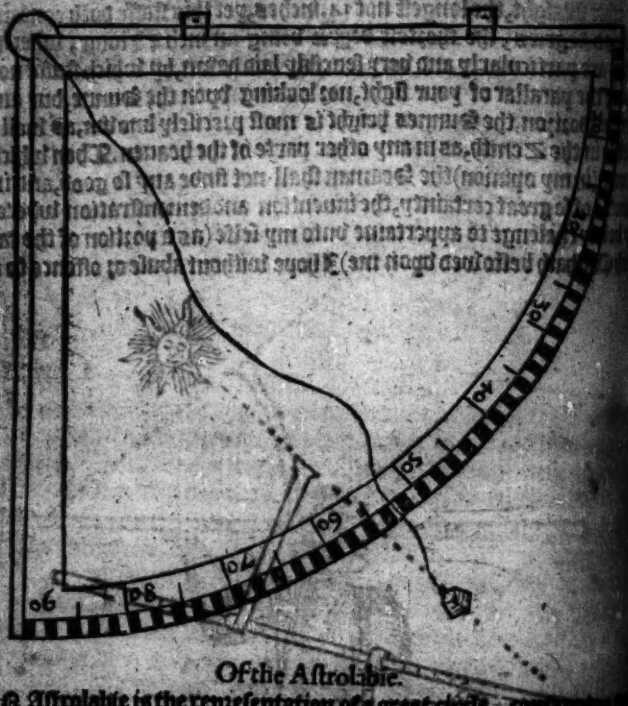


instruments whose degrées are of largest capacity, are instruments of certainty, I haue very carefully laboured to search a good and demonstrable means how a Crosse staffe might be projected, not onely to contayne degrées, but also to auoide the uncertainty of the sight, by disorderly [illegible] of the staffe to the eye, which demonstration I haue found, and haue [illegible] instrument in practise, as wel under the Sun, as in other climats: [illegible] it hath a large demonstration with manifolde vses, I heere o[illegible] manifest the same, purposing to write a particular treatise therof not[illegible] [illegible]ding his forme and vse, by picture I haue thought good to expresse. [illegible] staffe is a yard long, hauing 2. halfe crosses, the one circular, the [illegible] straight, the longest not 14. inches, yet this staffe doth contain the [illegible]00. degrées, the shortest degrée being an inch & ¼ long, wherin the [illegible] are particularly and very sencibly laid down, by which staffe not re[illegible] the parallar of your sight, nor looking vpon the Sunne, but onelye [illegible] Horizon, the Sunnes height is most precisely known, as well and [illegible] in the Zenith, as in any other parte of the heauen. Then which in[illegible] (in my opinion) the Seaman shall not finde any so good, and in all [illegible] of so great certainty, the inuention and demonstration whereof I [illegible] chalenge to appertaine vnto my selfe (as a portion of the talent [illegible] God hath bestowed vpon me) I hope without abuse or offence to any.



Of the Quadrant.

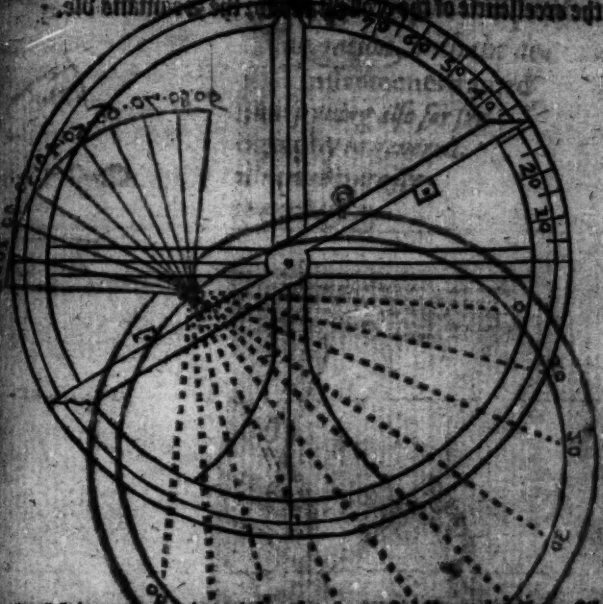
A Quadrant is the fourth part of a circle, containing 90 degrees, [illegible] presenteth the distance betweene the Horizon and Zenith, [illegible] cellent instrument vpon the shore, to perfourme any Astronomical [illegible] tions, but for a Seaman it is to no purpose: and although there [illegible] ry much written of the commodious and excellent vses of the [illegible] not being an apt instrument for Sea obseruations, it shall be from [illegible] pose to write further thereof, and therefore the onelye laying [illegible] forme may at this present suffice.



Of the Astrolabie.

An Astrolabie is the representation of a great circle, com[illegible] quadrants, or 360. degrees, which instrument hath beene in [illegible] mong Seamen, and is an excellent instrument being rightly [illegible] and ordered, but sith the vulgare Astrolabie with his vse is to euery [illegible] sufficiently knowne, it should be vaine labour for me to lay downe [illegible] and demonstration: therefore by his fourme it shall suffice to expresse [illegible]

any obseruation by those instruments, whereby the Seaman may [illegible] red of the la, which he sketch, but the obseruations made by the [illegible] are without all distrust of errour, and therefore no instrument may [illegible] with the excellentie of the [illegible] the Seamans vse.

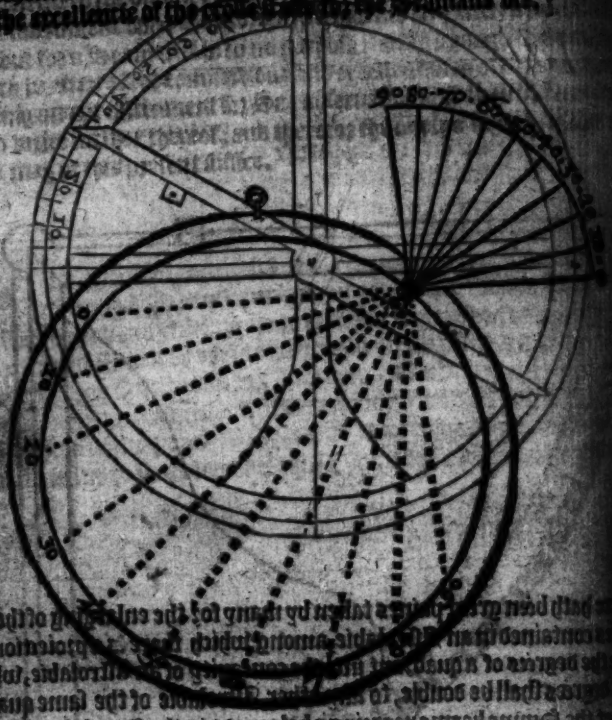


There hath béen great paines taken by many for the enlarging of the degrées contained in an Astrolabie, among which there is a projection to [illegible] the degrées of a quadrant into the concauity of an Astrolabie, wherby those degrées shall be double, to any other Astrolabie of the same quantitie, so that the Sunne beame pearcing a hole made in the side of the Astrolabie, is thereby caried to the degéers noted, in the opposite concaue parts, as [illegible] forme may appeare.

Also my selfe labouring in the same matter, haue found a meane wherby [illegible] of a quadrant whose side is 10. foote, may be conueied into an Astrolabie of 10. inches diameter, whose dioptra shall cut his lymbe to right an[illegible] shall perform the complement of [illegible] degrées [illegible] as by the quadrant it may in any sort be done.

[illegible] demonstration, together with the demonstration of my Staffe, I [illegible] God willing, at large to manifest. But there can be no inuention [illegible] establish the certainty of the vse of either Quadrant or Astrolabie at [illegible], for vnlesse it be in very smoothe water, there can be no certainty of

any obseruation by those instruments, wherby the Seaman may [illegible] red of the la. which he seeketh, but the obseruations made by the [illegible] are without all distrust of errour, and therfore no instrument may [illegible] with the excellencie of the crosse [illegible] for the Seamans vse.



FINIS.

Imprinted at London by Thomas Daw[illegible] dwelling neere the three Cranes in the Vin[illegible] [illegible] 1599.